Introduction *1.0*

Industrial operations of various kinds in the forests, rangelands and watersheds have been an integral and important part of the economy of this country since colonial times. Logging and mining have always been with us. In the past 100 years, drilling and operating wells for petroleum and natural gas have assumed major importance. In the past 50 years the development of powerful, high-capacity, earth-moving equipment has accelerated dam and mountain freeway construction and large-scale, open-pit mining. During the past 25 years, large-scale housing development has accelerated and moved into wildlands and leveling of land for agriculture and construction of canals and pipelines for water distribution has moved from the valleys into the foothills and mountains necessitating the use of heavy earth-moving and construction equipment. Activities that have taken place during the past years include construction, drilling and operating geothermal steam wells and power plants, construction of nuclear power plants, and oil, gas and mineral exploration operations.

Historically, these activities have not resulted in an unusual number of wildfires compared to other causes. However, several large fires have been caused by operation of machinery. This has led to aggressive fire prevention programs by fire protection agencies and industry in order to reduce fire losses and save money. The beneficial results from this effort can be easily and quickly negated by a careless act or negligence. Knowledge and constant practice of fire safe activities are necessary to avoid unacceptable fire loss.

Many aspects of machine use may start vegetation fires. These include exhaust sparks, hot exhaust manifolds and pipes, fuel leaks, overheating, track and blade sparks, short circuits, brakes, belts and pulleys, accumulated debris, and broken hydraulic line spilling on hot engine parts.

Burning of natural debris and vegetation for land management purposes is becoming more common. The specific purposes may include fire hazard reduction, seed bed or planting site preparation, land clearing prior to construction, mining or drilling, etc. In any event, past wildland suppression policies have led to an unnaturally heavy vegetative fuel loading in many cases, thus making some burning operations quite hazardous. Unless conducted under properly prescribed and controlled conditions, such burning can escape and become a wildfire. If well done, it cannot only produce the desired land management purpose, but also reduce the likelihood and severity of future wildfires.

Objective and Responsibility *2.0*

I. OBJECTIVE

The basic objective of this guide is to prevent uncontrolled fires, minimize loss of life, property and natural /cultural resources and the disruption of commercial operations as a result of wildfires.

II. RESPONSIBILITY

A. Cooperation

The most effective means of attaining the above objective is a cooperative approach. The ways in which cooperation can be implemented can include, but certainly are not limited to, joint training sessions, joint inspections, notification of critical fire weather, sharing of research and other information, supplemental fire detection and coordinated communications.

Fire protection agencies can no longer afford to maintain the personnel and equipment required to prevent all seriously damaging fires. It is, therefore, necessary for industry to assume some of the burden created by their activities. In addition, industry may be liable for damages resulting from fires caused by their operations.

Joint reviews provide excellent on-the-job training and promote mutual understanding and trust. It is easier to discuss and explain a situation or condition while looking at it.

B. Fire Danger

Wildland fire agencies, in cooperation with the National Weather Service, have a system for keeping informed of fire weather conditions, including critical situations. While this information is available on request to anyone needing it, it is computed for fairly large areas. Many operators want weather information more specific and localized to their own operating areas. They sometimes establish and operate their own weather stations. Agencies and operators benefit from the other's information. Also, managers of other types of industrial operations can make arrangements to obtain useful weather information from these sources, including the World Wide Web.

C. Responsibilities For Compliance

Industry has both legal and management responsibilities for fire safety in their operating areas. Fire protection agencies are responsible for assuring that the companies are in compliance with laws and regulations. The reasons for inspections may differ. Joint inspections are desirable and helpful, but may not always be practical.

D. Operating Company

Operating companies are responsible for the fire safety and compliance with the appropriate laws and regulations. They must determine what work is necessary to comply with laws, regulations and contract requirements, to prevent fires and to ensure safe and efficient progress of their operation. They also need to know whether or not the work has been accomplished and to what standards.

E. Protection Agency

The protection agencies' inspection responsibilities are primarily regulatory. They are expected to make fire prevention inspections of operating areas in accordance with agency policy. The protection agency should notify the company and take appropriate enforcement action when warranted. Agency investigations will also be conducted to determine the causes of fires that do occur.

F. Correction Of Violations

Correction of violations and risk and hazard reduction measures are generally the responsibility of the operating companies. The companies have an obligation to make their employees and contractors aware of requirements and to police themselves. Fire agency personnel should mitigate violations and report ineffective or unsafe fire prevention practices to the company.

G. Law Enforcement

Wildland fire protection agencies are charged with the responsibility of enforcing certain fire prevention laws and regulations. These agencies may initiate administrative, civil, criminal or injunctive actions to secure compliance with laws and ordinances.

Notes

Operating Areas *3.0*

Every industrial operation has an area on which its activities are conducted. Some of these areas, such as mines, are in fixed locations for long periods of time. Others, such as logging and construction, are mobile and transitory, remaining in one location for only a few weeks or months. For some, such as petroleum and steam wells, the nature of the activity and of the fire problem changes over time (drilling versus pumping and servicing). In all cases the access, for fire prevention purposes, routes between the scene of actual industrial operations and public roads are considered part of the operating area.

Operators may be adversely affected by fires starting outside or inside their operating area, and thus have considerable interest in preventing and suppressing such fires. Some fires, such as "Act of God" (lightning), can be expected to start either on or in the vicinity of any operating area. The operator has a responsibility to anticipate and plan for these and to take necessary action when they occur.

Some general fire precautions can apply equally to all types of industrial operating areas. These have been set forth in federal, state, and local regulations and contract requirements for the timber harvesting industry. They can be equally valid for mining, construction or drilling operations.

I. HAZARD ABATEMENT

This is a matter of recognizing, eliminating or reducing fire hazards to an acceptable level. Fire acceleration hazards that contribute most to increasing fire spread and intensity are slash, snags, spilled petroleum products and piles of any kind of flammables.

Ignitable hazards should be removed from all high risk areas. These areas include, but are not restricted to: refueling areas; locations of stationary or portable engines: welding, cutting or grinding operations; and personnel assembly areas where smoking and/or lunch or warming fires are allowed. They should be protected by creating clearings where all flammables have been removed. The width or radius of the clearing, in order to be effective, will vary with the nature and size by the risk from 10 to 25 feet. Under certain special high-risk situations, 50 feet or more should be considered.

Where such clearances are needed, they must not only be initially made, but also maintained.

General cleanliness of the operating area should extend to all machinery, structures and equipment. Machines should be kept free of trash and oil and free of slash debris and vegetative matter accumulation especially in the belly pan area on bulldozers. Structures should have regularly emptied receptacles for papers and other debris. Storage and servicing areas should not be allowed to accumulate papers, oily rags, and other waste materials.

II. SMOKING

In the past, smoking has been the reported cause of a high proportion of wildland fires (20%-40%) but in recent years, this statistic has changed markedly. The most recent published figures show a variation from 6% to 16% of fires caused by smoking, averaging about 11%. There are several reasons for this change. One is better fire-cause investigation and reporting. Another is the emphasis placed by Smokey Bear and other fire prevention campaigns on this cause. Still another is the restriction placed on smoking by many landowners and operators, including the public.

Still, 11% represents several thousand fires nationwide each year. It can be reduced if every industrial operator should adopt and enforces rules relating to smoking for the operating area. Most effective, of course, are the complete prohibitions such as those already in effect in

some companies. Other measures include: prohibition at certain times, usually based on fire danger rating; prohibition except in certain designated areas; requiring the smoker to find or make an area cleared of all flammable material; etc. Prohibition of smoking except in designated areas which can be made and maintained safe for this purpose is the course recommended for those companies which do not desire to totally prohibit smoking. At the very minimum, smoking should not be allowed except in an area cleared to mineral soil, or other nonflammable base, with a minimum diameter of three feet.

It is illegal to discard any burning tobacco products or matches from a moving vehicle. On public roads, state and federal officers and local authorities enforce this law. On private roads and operating areas, company rules should prohibit this practice and supervisors should enforce it. During critical fire periods, smoking should be prohibited.

III. LUNCH AND WARMING FIRES

Lunch and warming fires can be campfires in an industrial area rather than a recreational setting. Unless built, maintained and extinguished properly, they are as dangerous in one location as the other. Records indicate that a significant number of lunch and warming fires escape and become wildfires. By far the most common reason for these escapes is violation of one or more of the well-known and long-recognized safety rules for such fires.

Lunch or warming fires should never be built without first providing a clearing to bare mineral soil, or other nonflammable base, for a minimum distance of 10 feet in all directions from the expected perimeter of the fire. The fire should not be permitted to become any larger than actually needed to cook or provide warmth. The fire should never be left unattended until it is totally extinguished. Firefighting tools, especially a long-handled, round-point shovel, should be readily available in the immediate vicinity at all times the fire is burning or

glowing. Extinguishment must be thorough and complete, preferably with water and checked by ungloved hand. One person, ideally a supervisor, should be made responsible and held accountable for the safety of the fire. A fire patrol/fire watch, or other specifically assigned individual, should check all such fire sites not less than one hour, nor more than two hours, after the fire is terminated. Industry is often held liable for damage resulting from these unextinguished fires.

Fire Plans *4.0*

Fire plans are prepared by industrial operators, a copy of which should be filed with the responsible fire protection agency. The plans set forth the staff and equipment that can be used for fighting fire, the person to be contacted and means of contact, the locations and extent of the operating area and other pertinent data.

Each operating company should prepare its own fire plan after consulting with the local fire protection agency. The resulting plan becomes a useful tool for the operator and the agency. This is important because a fire plan is not likely to be useful in achieving its purpose without the personal commitment to fire safety of the owner or general manager of the operation.

Items included in a fire plan are discussed in this section. Certain matters related to fire protection, but not usually specifically set forth in the fire plan are covered at the end of the section.

The Fire Plan should cover as a minimum:

- Scope or Purpose
- Responsibilities
- Fire Tools and Equipment
- General Regulations
- Emergency Measures
- Detection System
- Personnel and Equipment
- Maps
- Fire Protection Cooperatives
- Public-Private Meetings

Notes

Fire Plan Outline *4.1*

I. SCOPE

Define the scope of the project fire plan area. This should include all information regarding the impact of the activity, including types of activity, length of operations, operating standards, etc.

II. RESPONSIBILITIES

A. Operating Company

The operating companies must determine what work needs to be done in order to comply with laws, regulations and contract requirements, to prevent fires and to ensure safe and efficient progress of their operation.

B. Protection Agency

The protection agency makes fire prevention inspections of operating areas as often as their other duties and budgets will reasonably allow. They ensure that operating companies are complying with laws, regulations and contract provisions. The protection agency should notify the company of its findings even when the inspection has been conducted jointly with company representatives. Appropriate enforcement action is taken when warranted by the findings. Agency investigations will also be made to determine the causes of fires that do occur.

III. FIRE TOOLS AND EQUIPMENT

A. Tools reserved for firefighting purposes only, at certain locations may be required. These should be considered only as legal minimums. Many logging and construction contracts require more. Some operators may provide additional tools. Special requirements are contained in various rules and regulations. Below is a composite listing of locations and tools recommended at those locations. Local laws and rules should be checked.

Location	**Recommended Tool(s)**
Motor, torch, grinder, etc.	Shovel, backpump
Log landing, construction field office or service area, mine headquarters, etc.	Fire toolbox with enough tools to equip each employee, plus chain saw and tractor headlights
Motor vehicle, tractor, skidder, scraper, etc.	Shovel, axe, approved fire extinguisher
Portable power tool (including chain saw, tamper, etc.)	Shovel, approved fire extinguisher
Cable block	Shovel, backpump or fire extinguisher
Yarder, loader, crane, service truck, etc.	(2) 10 lb. fire extinguisher fire suppression system
Helicopter refueling area	(2) 10 lb. fire extinguisher fire suppression system
Choker setter	Shovel

Mechanized harvesting equipment (chippers, bunchers, etc.) powered by internal combustion engines	(2) 10 lb. fire extinguishers or self extinguishing fire suppression system

The fire plan should set forth the number and types of firefighting tools provided, their locations, and the person designated as responsible for ensuring their presence and operating condition. Personnel should be trained in their use.

B. Equipment

All firefighting equipment under the operator's control should be listed in the fire plan. The specially designed equipment (e.g., fire trucks, water trailers with pumps and hose) are rather obvious. Adapted equipment may not be so obvious to everyone. Bulldozers and chain saws can be used on almost any wildland fire. Road-watering tank trucks are not as useful as they might seem unless equipped with pumps and hose. In areas where trees, heavy slash and surface rocks are not prevalent and the terrain is not steep, motor graders are excellent firefighting machines. These are but a few examples. In preparing this section of the fire plan, an operator should seek the advice of fire protection agency personnel.

In addition to firefighting equipment, the fire plan should list support equipment. This category would include, but not be restricted to: fueling and lubricating vehicles, transport vehicles (e.g., low beds, buses, flat beds), communications links (e.g., radio-equipped vehicles, portable radios, radio-telephones), portable electric generators, etc.

All equipment listed should be designated as "with operator" or without operator." The location and means of contacting, as well as other pertinent and useful information should also be listed.

IV. GENERAL REGULATIONS

The fire plan should also include all of the pertinent information about:

A. State laws, regulations, and local ordinances

B. Permits required

C. Regulations for burning

D. Smoking and fire rules

E. Storage and parking areas

V. EMERGENCY MEASURES

Curtailment of Activities

It is seldom necessary to completely shut down industrial operations in the wildlands during fire season.

Normal operations should not continue when fuel and weather conditions get into the “very high” and extreme” ranges. The fire plan should set forth those high-risk activities which will be curtailed or stopped entirely at various levels of fire danger. This is common practice with large timber operators and public utilities. It should be incorporated into all industrial operation fire plans.

Some of the specific activities which should be considered for curtailment include: smoking, open fires, welding and cutting, blasting, and use of power driven machinery. Some that are normally safe to continue are servicing of equipment, watering roads, loading trucks, etc.

There are several systems of determining when and where such curtailments should take place, such as fire danger adjective ratings (e.g., high, very high, or extreme), some on codes indicated by numbers (e.g., activity level, burning index, fire load index, and drought index), some on special conditions. Some are based on predicted conditions, others on existing observed conditions. In most cases, the information is obtained from the protection agency, in others the operator establishes the weather monitoring system.

The most technically correct system is the National Fire Danger Rating System. It is based on weather, fuel and topography factors at the site in question (or a nearby representative station), and observations and predictions of the Fire Weather Forecasters of the National Weather Service. The system was developed through computer correlations and analysis of the factors affecting the ignition and burning of actual fires. Most wildland fire protection agencies have computer terminal access to this system. Private operators can get the information from the agencies.

No matter what fire danger rating system is used, it should be specified in the fire plan along with the types of operations to be regulated by it and the levels at which the regulations will become effective.

VI. DETECTION SYSTEM

The fire plan should also set forth how the operator and his employees will detect and report wildfires originating on or near the operating area to the protection agency. A system to be used for contacting the operator's employees in case of emergency must also be detailed in the plan. Fire detection can be accomplished in several ways. No single method is fail-safe, so the plan should incorporate two or more. The same can be said for alarm or communication systems.

Certain laws, regulations and contract provisions require a fire patrol/fire watch services at designated times and places (e.g., after daily logging operations, after blasting). Some of the larger operations may require full-time employees for this purpose. Smaller operators are often able to meet their legal and contract responsibilities by assigning employees hired basically for other duties to this activity at the times and places required. This usually requires either an offset work shift or the payment of overtime. In any event, during the time any person is performing as a fire patrol/fire watch they must not have any other assigned duties nor be allowed to engage in any activities which might divert their attention.

Since fire patrols or watchmen are often alone on an operating area after all other workers have left for the day, it is very important that they be provided with effective and reliable means of communication. This is not only necessary for fire reporting purposes, but also for personal safety. Since fire patrols or watchmen usually must be mobile, the best and most common way is to provide them with radio-equipped vehicles reporting to a base station or cell phones if within a coverage area.

Patrols should be made responsible not only for detecting and reporting fires, but also for taking initial suppression action on any fires they discover. Therefore, they should be physically fit, equipped with firefighting tools and equipment and fully trained in the effective use of such tools and equipment. Personal protective clothing is highly recommended for this type of work.

It is good insurance to assign other personnel additional duties as auxiliary fire patrols. These people, who might be on the operating area outside of normal working hours (e.g., equipment service personnel, security guards), however, will not be accepted as substitutes for or in lieu of the patrol/fire watch required by law or contract.

Detection of fires can also be accomplished by fixed lookouts and aerial patrols. Both systems are timber operators and timber landowners. Both are adapted to broad area coverage, are rather expensive, and have blind spots and certain times when they are not effective. Their best use, therefore, is as supplemental or backup systems to the ground patrol. In most cases their costs are borne cooperatively by multiple adjoining or intermingled owners and operators or public protection agencies.

A relatively recent development for increasing the effectiveness of aerial patrols is the infrared scanner. Originally developed for military purposes, this equipment was adapted a few years ago by public agencies for wildfire control and detection purposes. Timber operators and agency fire management officers are using portable hand-held infrared detection equipment for slash burning surveillance to reduce the cost of maintaining holding crews and mop up crews and equipment. Such equipment is also useful for detecting the presence of any other ignition source when smoke or darkness makes other means of detection difficult or ineffective; however, it will not work through atmospheric moisture (i.e., fog or clouds). Several hand-held models are also now commercially available.

VII. STAFF AND EQUIPMENT

A. Person In Charge

Fire prevention or suppression can only be effective when organized. Someone must be in charge and responsible in order to provide direction to this effort. This can be the owner, logging boss, construction superintendent, a person specifically hired as fire supervisor, or anyone else who is readily available at all times and is assigned the necessary authority to commit the resources of the operator when and where needed. This person should not only be named in the fire plan, but his/her identity and authority should be made known to all employees, contractors and subcontractors. For operations with more than

a few employees and pieces of equipment, an alternate and/or assistants should be designated. All of these people should not only have the requisite authority, but also fire protection training and experience in excess of the general run of employees so they may effectively lead fire prevention and suppression activities.

In addition to naming the person in charge, alternate and assistants, the fire plan should set forth positive means of contact, both at work and off duty. Day and night telephone numbers are minimum requirements. Radio frequencies received and transmitted on are helpful. If direct contact by the protection agency dispatcher is not possible or practical, the means of routing messages to the company fire boss should be outlined. Currently, pagers and cell phones are popular means of communication.

B. Staffing

Wildland fire suppression is an extremely labor-intensive undertaking. A fire of more than a few acres in size, particularly in heavily timbered areas, may require hundreds of firefighters days to suppress and mop up. Fire protection agencies can no longer afford to keep large numbers of persons needed to fight major fires on their payrolls. Firefighting crews are often transported from across several states to suppress large fires. Therefore, the fire plan needs to list the number of people locally available by various skills, day or night, weekends, etc. This allows for quick response by the operator's personnel to assist the fire protection agency until sufficient help arrives to completely suppress and mop up the wildfire. Many agencies utilize private contract crews and engines to augment local resources. This requires close coordination with fire protection agencies.

Except for persons who, by virtue of fire control training and experience, are designated as crew leaders it is usually

unnecessary to list employees and subcontractors by name in the fire plan. However, particularly in timber country, certain skills (e.g., timber fallers, bulldozer operators, pump operators) could be more critical than laborers. The special skills involved are those related to firefighting and not to the primary activity of the operation. For instance, operating a bulldozer to fight fire is quite different than operating one to yard logs, build a road or excavate ore. With this in mind, the number of personnel available should be listed by various skills. Local OSHA requirements should be considered when identifying personnel and resources available in the plan.

Availability does not remain constant over time. A maximum number will normally be available during regular working hours. Somewhat less can be expected to respond at night. Even fewer will be available on weekends and holidays. Therefore, the fire plan should indicate expected availability in at least the above categories. Several large timber operators maintain rotating standby schedules, particularly for supervisory personnel, for weekends and holidays.

Also, because of the extended duration of many wildland fires, the need for and availability of relief personnel should be provided for in the fire plan. Thus, the fire plan should provide at least two people for each position: one for immediate response and one for relief on the next operational period. This may not be necessary for laborers as their relief may be transported in from a considerable distance; however, for the operators of machinery it is quite important.

C. Training

The employees of any company conducting operations in wildland areas may be called upon to fight fire. These employees are expected to have the basic skills required to do this effectively and safely. Therefore, it is in the best interests of the company to provide essential firefighting training.

Fire training for employees of any company will normally be tailored to the particular needs of that group. Some may have had considerable firefighting experience, others little or none. Some may use hand tools every day, others never. Many who do use hand tools use them only for a specific purpose and are unaware of ways in which they can be used to fight fire. Most are not knowledgable regarding the special hazards involved in fighting wildland fire. Any such training should include the following subjects plus any others deemed necessary for the particular group:

1. Basic fire organization.

2. Safety equipment.

3. Introduction to fire behavior.

4. Sizeup and initial attack.

5. Hand-line construction principles and methods.

6. Use and maintenance of tools.

7. Ten standard firefighting orders.

8. Using water in suppression.

9. Mopup.

10. Abandoning the fire.

11. Air support—safety.

12. Transportation.

13. Communications radio use—ground/air signals.

14. Outfitting oneself.

15. Locating fire.

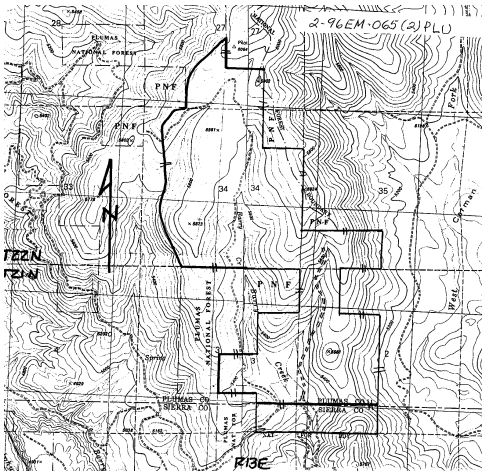
16. Foot travel.

17. Survival tips.

18. First aid.

19. Personal protective Equipment.

VIII. MAPS



The map is an integral part of a complete fire plan. It should be of sufficient scale and accurate enough to be of use. Contours are not necessary but should be provided if possible. Main ridges and drainages should be indicated. U.S.G.S. quadrangle maps are good base maps. Ownership and operating area boundaries should also be shown. All roads, landings, equipment servicing areas, field offices, other structures, and other significant features should also be indicated. Reasonable accuracy of scale, distance, direction, etc., is important. G.I.S. systems should be considered.

IX. FIRE PROTECTION COOPERATIVES OR ASSOCIATIONS

The purpose of fire protection cooperatives or associations is to implement and coordinate the use of industrial staffing and equipment to fight wildland fires and to provide liaison between industrial and public fire control forces. A cooperative may hire a forester-firefighter. This individual collects copies of timber operator fire plans, attends industry-agency meetings, assists in training and physical testing, assists agency dispatchers in ordering, assigning and demobilizing industry forces during fires, etc.

X. PUBLIC-PRIVATE MEETINGS

Public agencies and industrial operators can be in supportive roles. It has been found that coordination and understanding can be gained by meeting once or twice a year to discuss mutual problems, plans and results. This principle applies to all wildland industries.

The most productive meetings are those including middle and upper level management personnel and fire protection specialists from both public agencies and industrial operators. Specific problems should be addressed and solutions agreed to. Spring or pre-fire season meetings are particularly appropriate for planning fire control operations. Fall meetings are good for reporting results, planning fire prevention activities and meeting budgeting deadlines.

Inspection and Safety *5.0*

Industrial operations of any kind in the wildland are potential sources of wildfire. As such, they require inspection to ensure protection of the operator, the public and neighboring property owners. In addition to fire laws and regulations, such operations are governed by many safety rules. It is important that personnel required to make fire prevention inspections comply with these safety rules. Safety rules are assigned to protect workers, not inspectors, and it is sometimes difficult to make certain inspections and, at the same time, comply with all safety rules. For their own welfare, inspectors must not violate safety rules. They should always wear hard hats and other appropriate personal protective equipment. Avoid slick-soled boots.

This section will discuss various types of inspection procedures, safety rules, reporting procedures, legal actions which may result from inspections and methods of identifying items inspected.

I. INSPECTION RESPONSIBILITIES

Industrial operation fire prevention inspections are made by both the operating companies and the fire protection agencies. The reasons for and the timing of these inspections may differ, but there are advantages to both parties by sometimes making joint inspections.

A. Company Inspections

1. The responsibility for inspecting operating areas and equipment for compliance with laws and regulations, maintenance of uninterrupted production and avoidance of civil liability rests exclusively with the operating companies. Fire protection agencies primarily inspect for compliance with laws and regulations. When equipment owned by one company is being operated by another under a lease or rental agreement or when work is being performed by a subcontractor, the ultimate responsibility and liability may be established in the contract. The operating company is the one which the protection agency will normally deal with and hold responsible for compliance with the law. It is the responsibility of the owner or management personnel of each company to determine how, when and by whom its inspections will be carried out.

2. It is hard to determine how often inspections should be made because the sizes of companies and the types of operations vary so widely. Each company must determine its own appropriate inspection schedules. Some company rules establish inspection schedules and procedures either more frequent or more intensive than those required by federal or state laws and regulations. A good inspection schedule is daily by operation supervisors and every 10 days by fire prevention or safety specialists. Fire danger conditions may be a determining factor for frequency of inspections.

B. Protection Agency Inspections

Laws charge fire protection agencies with the responsibility for protecting the public from the loss of life, property and resources by fire. They are also charged with enforcing forest and fire laws. To accomplish these missions they inspect industrial operations in order to prevent wildland fires. Public fire protection agencies have a duty to make known to operating companies those violations and defects they observe during their inspections. Protection agency inspections do not, however, relieve operating companies of the responsibility of making their own inspections. Fires resulting from deficient operations may result in a liability to the operator.

1. Fire agency inspections are generally of two types: routine and fire emergency. Routine inspections will usually be general surveys of operating areas and spot checks or sampling of mechanical equipment. These may be original inspections or compliance checks following prior notification of violations. The inspector should make every effort not to interfere with production.

2. Fire emergency inspections or investigations include point of origin and ignition source determination, as well as identification of the specific machine or person that provided the source of ignition. This is not merely for the purpose of providing data for statistical reports and fixing liability, but also to release non-offending personnel and equipment back into production as soon as possible and to help determine effective fire prevention measures, including design changes if needed.

3. Most routine inspections can be adequately performed by visual inspection. Inspectors should be equipped with such aids as Fire Prevention Field Guides, tape measures, notebooks, cameras, inspection stickers, “red tags” and

copies of applicable laws, regulations, contracts and agreements.

4. The results of any fire agency inspection should be properly recorded. Each protection agency has its own forms and procedures for this purpose. All violations should be recorded according to agency procedure. Inspections may be recorded on forms, memos, formal letters, etc. Regardless of the format of the inspection report, a copy should be sent or given to the company. Reports should be specific enough for the company to act on them and for the courts to relate them to complaints or other legal actions in the event such actions are filed.

5. Protection agency personnel may have occasion to observe conditions on equipment or operating areas other than violations of fire laws or regulations that may be dangerous, or a violation may be observed that is outside the inspector's jurisdiction. These conditions should be reported to the company as soon as possible. If they have contributed to a fire, or are likely to, they should be recorded and dealt with immediately.

C. Joint Inspection

1. Joint inspections are for the purpose of acquainting both fire protection agency and company personnel with potential violations and other problems and conditions. They often result in mutual agreement on methods of correcting problems. Joint inspections are not always possible due to time commitments or because of company or agency policy. They are, however, encouraged to the extent possible. The joint inspection provides an excellent opportunity for mutual understanding of the problems facing both industry and

the agency, as well as training opportunities for both participants.

2. Because of the safety hazards and security policies of many companies, inspections should be joint and by appointment. On the other hand, insisting on company representation during inspection of a small operation may result in essentially complete shutdown, thus creating a economic hardship. In such a case, mere notification of the presence of the agency inspector is often adequate. Laws governing public agency authority for inspections provide the framework for this activity. These laws may vary by agency or geographic location.

II. INSPECTIONS

A. Mechanical Inspections

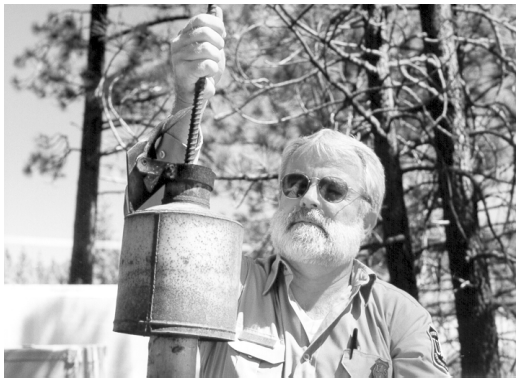
The potential source of ignition for wildland fires during industrial activity is mechanical equipment. The most common part of the machine to directly cause wildfires is the exhaust system. Several laws have been passed as a result of this fact. However, other potential heat sources cause fires and should be included in a complete fire prevention mechanical inspection.

When fire prevention inspections of machinery are made with the engine running, extreme caution must be exercised to avoid contact with exhaust systems, fans, belts, exposed gears, etc. Also, if the machine is mobile, the brakes should be set and attachments such as blades and buckets must be lowered to the ground. Blocking of wheels or tracks is an additional safety precaution that is good practice. If possible, inspect machinery when it is not running.

1. Exhaust Systems

a. Exhaust systems start fires in two ways: emission of carbon sparks and direct contact with flammable materials. Contact with flammable materials may happen in either of two ways: by collection of flammables on manifolds and inside shields or parking where flammables touch, or come in close proximity to, pipes and other components. Potential problems from sparks and collection of flammables are detected by inspection of the machine itself. Problems from potential contact will be revealed by inspection of the operating area and of company rules and regulations.

b. All internal combustion engines operating on forest, brush or grass-covered lands should be equipped with an effective spark arrester. Muffler-equipped trucks, buses and passenger vehicles (except motorcycles) may be exempt, unless the system has been modified. However, if they are used regularly and primarily off-road in such areas, it is good fire-safe practice to equip them with spark arresters in addition to mufflers. Turbochargers are normally accepted by fire protection agencies in lieu of spark arresters, so long as everything is in good working order and no exhaust gases (including crankcase breathers) are put into the exhaust system downstream from the turbocharger. Not all turbochargers prevent fuel sparks. Each turbocharged exhaust system should be inspected as thoroughly as normally aspirated exhaust systems that require spark arresters.



Specific requirements or restrictions for internal combustion engines may be regulated by agency industrial fire precaution levels or other industrial regulations.

c. Spark arresters are of two types. By far the most common is the retention arrester. Depending on make and model, this type of arrester will be fitted with a band covering ports or a plug through which trapped carbon particles are removed. The inspector should remove the band or plug to determine whether the arrester has been recently emptied and is functioning properly. Excessive amounts of carbon (i.e., enough to fall out when the band or plug is removed with the engine shut down) found inside constitute a violation. If the machine has been recently shut down, the inspector should wear gloves to prevent burns.

d. The other type is the attrition arrester. This arrester will have no clean-out arrangement. It is much more difficult to inspect. The only sure way is to fit a screen of maximum legal-size mesh (.023 inch) over its discharge and observe whether or not any carbon particles are trapped inside the screen during a period of test operation of the engine. Another way would be night observation during normal operation of the machine to observe whether or not incandescent sparks are emitted.

e. Both types of arresters, as well as mufflers, should be checked, either visually or by a probe, to learn if they have been altered internally and are no longer anything but a disguised straightpipe. Spark arresters are manufactured in models designed to perform only in either a vertical or horizontal

position. The inspector should determine that the arrester is not installed improperly. An improperly installed spark arrester will not function effectively. Machines with defective spark arresters should be prohibited from use.

f. The U.S. Forest Service publishes a "Spark Arrester Guide" which lists approved spark arresters by make and model together with the type of machine and position of which they are approved. Every inspector, vendor and owner should be familiar with this publication. This publication is available at the National Interagency Fire Center, Boise, Idaho.

g. The most common place for flammables to collect on an exhaust system is the exhaust manifold. The exhaust manifold can become a collection point on any internal combustion engine, gasoline or diesel. Screening the engine compartment, reversing the fan or other design changes can often alleviate the problem. However, it can seldom be completely eliminated and the inspector should always check for accumulations at this point. Cleaning of compartment areas should always be made part of routine maintenance.

h. Catalytic converters have been considered responsible for markedly increasing the risk of fire caused by the exhaust systems of gasoline-powered vehicles. Properly installed and maintained catalytic converters themselves do not significantly increase the fire starting potential of exhaust systems through direct contact. The temperature of the exhaust pipe is already well above the ignition temperature of dry grass, leaves and needles. On the other hand, the shields installed around many

converters to keep them from contacting such flammables often have the opposite effect (i.e., they collect the vegetation between the shield and the converter where it may catch fire and drop out onto a receptive fuel bed). Inspectors should check for such accumulations.

i. Catalytic converters and the tail pipes behind them can sometimes reach temperature as high as 2000° F. This is the result of a malfunctioning engine (e.g., misfiring spark plug, dirty air cleaner) allowing unburned fuel into the exhaust system. Under such conditions, the fuel actually burns in the converter instead of in the cylinders. For this reason, the engines of vehicles equipped with catalytic converters should be well maintained and tuned-up frequently. Catalytic converters that frequently operate above specified temperatures can break down or fracture, expelling internal components, these superheated elements are a likely source for fire starts.

2. Miscellaneous

a. Many wildland industrial operation fires start from the machine itself catching fire and transmitting the fire to vegetative fuels. For this reason, the inspector should not only inspect the machine for potential ignition sources, but also for the presence of firefighting equipment, including both a suitable fire extinguisher and appropriate hand tools, especially a shovel.

b. The most common source of machine fires is the fuel system, including refueling procedures. Although this statement applies to all internal combustion engine equipment, it is particularly true

of gasoline engines. This is because of the high volatility of gasoline, its low ignition temperature and the tendency of its fumes to travel in flammable concentrations. Agency inspectors are not expected to be mechanics, but they should at least look for any obvious leaks or signs of wear or vibration in fuel lines, especially the high pressure lines from the pump to the injectors on diesel engines. Operating company mechanical inspections should be made by mechanics. Inspectors should assure themselves that engines are always shut down and positioned in a sufficiently large area cleared of all flammable materials during refueling.

c. Other items on engines which should be checked during a fire prevention inspection include: worn, cracked or deteriorating insulation on electrical systems; loose or worn belts; worn or dry bearings and gears; flat tires, especially inside duels; low fluid level and/or heating in automatic transmissions and torque converters; overheating brakes; etc.

B. Operating Area Inspections

Fire prevention inspections of operating areas are made to determine the nature and extent of fire hazards present, the effectiveness of measures taken to abate them, and compliance with requirements for clearings, signs, smoking practices, extinguishers, tools, etc. For most operations, even large ones, it is best done from the ground. Equipment servicing areas are normally accessible by vehicle. Often the most critical area is near the perimeter of the operating area, accessible only by tracked machines or foot. This is also often true of operations involving chain saws, air drills, cutting and welding equipment or other portable machines.

C. Identification of item inspected

Proper identification of the item inspected is quite necessary to avoid misunderstanding, inappropriate corrective action, or enforcement problems. Place or brand names alone are inadequate. There may be two Bear Creeks within a few miles of each other. A single operation may have several bulldozers of the same make and size working. The agency inspector needs to be flexible in his/her approach to identification as he/she is usually responsible for inspecting several different types of industries and what is meaningful to one may not be to another.

1. Location

a. Location of the area or item inspected can usually be given by section, township and range or other coordinates. This is meaningful to both the protection agencies and the timber industry. It may not be to other industries. For them, additional location information such as pit number, lease name and well number, project name, or centerline distance number will be necessary. For the timber industry, an additional landmark location description is helpful.

b. When section, township and range or other coordinates are used, the location should be given as precisely as possible. There may be several ownerships, and/or operations within a single section. It is not difficult with modern topographic maps to determine location within a quarter section. In many cases, quarter-quarter section (40 acres) designation is entirely practical.

2. Equipment

Equipment should be as fully and precisely identified as reasonably possible, even if there is only one of a type present during this inspection. Upon return, the inspector may find a substitute or several additional units. The most obvious identification is the brand name and type, such as bulldozer, yarder, end loader, or compressor. In addition, the size and serial number should be recorded. Some operators provide their own identification numbers on the machine. These are easier to use than serial numbers.

III. LEGAL ACTIONS

Inspections or fire-cause investigations may lead to any one or a combination of legal actions. Since these actions are sometimes misunderstood and confused with each other by both agency and company personnel, each will be briefly described here.

A. Administrative

1. Administrative action is a legal action; however, a court is not involved. It is, however, a formal notification of violation of a law or regulation and a notice to correct the violation, usually within a specified time. It becomes a matter of record and may serve as the basis for more stringent action later. The administrative action, in addition to being a legal notice, becomes a documented history.

2. Administrative action is initiated by the protection agency and addressed to the operating company. It may take any number of forms. A notice for internal combustion engines may be affixed to the machine itself and can serve as notice of violation and an order to shut down the engine and not place it back in service until the violation is corrected.

3. Administrative action may also come in the form of a letter, memo, telegram, etc., from the inspector or supervisor. Letters of demand for damages or costs of suppression fall in this category as do actions to suspend or revoke licenses and permits.

B. Civil

This is a filing, with a court of appropriate jurisdiction, of a suit for damages or costs of fire suppression, or both. It is seldom filed unless a letter of demand has been ignored or denied. In some cases, liens may be filed to secure cost recovery.

C. Criminal

Criminal action is usually initiated by a citation or complaint. Most criminal actions coming from violations of fire laws or regulations are misdemeanor actions. Such actions may name as the defendant either the company or the employee who was found committing the act, or both. If the company is named, the only penalty possible is a fine. If an employee is named, the penalty may be a fine and/or a jail term.

Notes

Maintenance, Repair and Servicing *6.0*

The use of machinery vastly increases labor productivity, but it also provides some problems, not the least of these is that it requires continuous maintenance, repair and servicing. If maintenance, repair and servicing of mechanical equipment could be done in shops or corporation yards, the threat of wildland fire from these activities would be negligible. This, however, is not the case and such activities often take place in highly fire hazardous situations.

I. WELDING, CUTTING AND GRINDING

The primary fire risk from these activities is the falling of sparks, slag or hot metal into dry vegetative fuel beds. There is also some risk of ignition of fumes from volatile fuels or solvents. The electric arc or gas flame itself is such an obvious heat source that it is seldom allowed to contact vegetation or other fuels.

Welding, cutting, and grinding are often done as emergency repairs to get a disabled machine moving again. This means that the choice of time and location is severely limited or nonexistent. The machine may very well be situated in the middle of a hillside covered with dry grass or pine needles. Before any arc is struck or other repair work started, the area should be made as fire safe as possible. All flammable vegetation and other fuels should be removed for a minimum radius of 10 feet from the area to be worked in. Several companies regularly provide 25 feet clearance. Also, firefighting equipment, including a backpack pump water type fire extinguisher and shovel, should be provided close by (i.e., less than 25 feet from the activity). When fire danger rating is "Very High," or when winds prevail, a larger clearing radius should be employed. When fire danger rating is in effect, all welding, cutting or grinding activities in the field should be stopped. Whenever welding, cutting or grinding is done in the field, a fire watch should be on hand during the operation and left at the site for at least one hour after the completion of the repair. A welder wearing a hood or dark goggles can seldom see a vegetation fire. During high fire danger periods, industrial fire precaution levels may prohibit this activity during certain hours.

Spark arrester and clearing requirements are applicable to portable generators supplying power to arc welders and grinders. It should also be remembered that the operator will not lose his/her responsibility and liability, although may share it, by using an independent contract welder rather than an employee. He/she must be sure the professional welder is aware of and follows fire safe practices and complies with the law.

Much of what is discussed is included in various timber sale and construction contracts, state law and in some local ordinances. In those jurisdictions where welding permits are required, clearance and fire tool requirements will usually be included among the conditions of the permit. Fire conscious operators will take these precautions voluntarily.

II. REFUELING AND LUBRICATION

Whenever possible, refueling and lubrication should be done at properly equipped and cleared shop or yard areas. On logging and many construction operations, this may not be feasible. In these situations, certain precautions should be taken. In the interests of both fire prevention and water pollution control, all drain oil, used oil filters, rags and other trash should be disposed of by complete removal from the site. These items should be transported to and deposited in an approved waste disposal site.

Wheeled or tracked machinery is usually serviced from a truck, which means it will normally be brought to a log landing or other similar cleared area accessible by the service truck. If this is not the case or if portable equipment (e.g., chain saws or small generators) is being refueled, a clearing to mineral soil for at least a 10-foot radius should be made and the unit to be serviced placed in the center before any fuel transfer takes place. For both fire and personnel safety, all power units should be shutdown and cooled before being serviced. Before restarting, spilled fuel should be wiped off portable units and the units be moved at least 3 feet and positioned so that the exhaust points away from the spot where refueling took place.

Fuels, especially gasoline, should be stored according to local regulations. Above ground storage in quantities in excess of one 55-gallon drum should be avoided. In any event, a clearing of all vegetation and other flammables should be maintained for at least a 15-foot radius from the container and/or pump.

Laws, ordinances or regulations in many places require that a dike of sufficient height and area to retain the entire contents of the tank in case of rupture or overflow be constructed around any tank of 500 gallons or larger capacity. Such quantities of fuels should not be stored within 250 feet of a live stream or 50 feet of any vegetation. Fueling hoses should be fitted with automatically closing valves and nozzles to shut off the flow of fuel in case of hose rupture or nozzle dropping.

III. SERVICING EQUIPMENT

The equipment used to supply servicing is subject to the same laws and regulations as the equipment being serviced and for the same reasons. The exhaust from a pump engine or air compressor engine is just as dangerous as that from a tractor or a truck. Thus every internal combustion engine must be equipped with a spark arrester. The only exemption is for muffler-equipped motive power engines on trucks, buses and passenger vehicles. All other engines mounted on such vehicles (e.g., to power fire pumps, compressors, generators, etc.), mounted on trailers or skids, or hand portable, must be spark arrester equipped. In addition, if the unit is not mobile or is to be operated in a given location for a time, a clearing of flammable material shall be made around it for a radius of at least 10 feet and firefighting tools provided nearby.

Service vehicles, including fuel trucks and mechanics' trucks, should be equipped with large (i.e., 20-40 lb.) multipurpose fire extinguishers. The operators of the vehicles should be well trained in the use of these extinguishers. They are often alone and in remote locations when servicing or repairing machinery. It is, therefore, very important that they be capable of quick and effective fire suppression action in case an ignition occurs from any cause.

Standard non-spark arresting exhaust systems may be prohibited for off-road use during high fire danger periods or regulated use closures.

IV. SPARK ARRESTER SERVICING

An item often overlooked or given inadequate attention during servicing of machinery is the spark arrester. Every mechanic, operator and owner knows that the air cleaner on an internal combustion engine must be regularly cleaned or replaced; if it is not, the engine loses power. They are, therefore, generally very conscientious about performing this service. The need for cleaning or emptying the spark arrester is not so apparent. Except in the case of screen-type arresters (usually found only on small multi-position engines) the performance of the engine is not affected. Therefore, there is little to remind the operator that the arrester needs cleaning. However, when the trap is full (or the screen burned out) the arrester completely loses its effectiveness and carbon sparks will be emitted. Spark arresters should be checked and cleaned regularly and often (every 30 days or less). The proper way to do this is to make sure the machine is parked in a cleared fire-safe area, remove the band or plug and then start the engine and blow out the carbon.

Notes

Explosives *7.0*

Explosives are used by numerous wildland industrial operations, especially construction and mining. When their use is kept in the hands of experienced personnel, their fire starting potential has proven to be low. However, in the hands of untrained or illegal users their potential for both fire and blast damage is great.

I. LEGAL REQUIREMENTS

A. There are federal, state, and local laws governing the manufacture, sale, transportation, storage and use of explosives. It is primarily aimed at protecting the public from blast damage and from theft, terrorism, illegal possession and use. These laws are usually administered by law enforcement rather than fire agencies. Fire agencies are often unaware of the existence of explosives within their area of jurisdiction. When they are aware of explosives within their jurisdiction, they need to notify all fire prevention, detection and suppression personnel in the area. For this reason, some fire agencies may require blasting permits in addition to any other required explosive permits, and in addition, the contractor may be required to notify the local fire agency of the legal location of the explosive so that appropriate personnel can be notified. Be aware of new laws that require notification to the jurisdictional fire agencies.

B. Regulations of the Federal Bureau of Alcohol, Tobacco and Firearms (27CFR55.41) provide for explosives licenses and permits, classes of explosive materials, types of storage facilities, location of storage facilities, construction of storage facilities, quantity and storage restrictions, and required distances from exposures. Included among these regulations is one (27CFR55.215) which states, “The area surrounding magazines, or trees (except live trees more than 10 feet tall),

for not less than 25 feet in all directions. Volatile materials are to be kept a distance of not less than 50 feet from outdoor magazines. Living foliage which is used to stabilize the earthen converting of a magazine need not be removed."

II. MAJOR CAUSES

In wildland fire protection, three main problems are related to explosives. One is use of fuses rather than electric detonation. If properly placed, the explosives themselves will seldom ignite a fire. Cordite, primacord, or other burning fuses, however, will not only ignite forest fuels, but short pieces can be thrown considerable distances by the explosion and can cause multiple fires where they land. Therefore, it is recommended that all blasting in forest, range or watershed areas be detonated electrically. Consider all explosives capable of starting fires.

Second is the heat of the explosive detonation. The rapid (instantaneous) oxidation of the explosive chemicals produces great heat in a small space and time. In contact with, or in close proximity to flammables, such heat will cause ignition resulting in fire. If clearance is not provided, the explosive charge will be in close proximity to forest fuels.

The third fire problem is storage. This problem has two aspects. One is security. More explosives are stolen from temporary caches on construction and logging projects than from any other location. This is primarily a law enforcement problem; however, significant amounts of the stolen explosives end up being used in the wildlands by untrained and inexperienced people and thus become a fire problem.

Explosives becoming exposed to wildfire is the other aspect of the storage problem. Magazines and caches are often deliberately camouflaged and their locations are usually kept secret as protection against theft. This means that they are often in close contact with forest fuels and firefighters seldom know where they are. In the interests of

fire safety, all magazines and caches for explosives should have a clearance of flammables around them similar to that required for structures in wildland areas. Some companies provide clearances up to 100 feet. If this cannot be reconciled with the security problem, some other means (e.g., insulation) should be employed to keep the radiated heat of a forest fire from detonating the explosives inside.

Even with the best of control, a certain risk of fire is always associated with the use of explosives in wildland areas. Wildland fuels may be present in an unknown proximity; sparks may be struck by quartz or flint rocks, or some malfunction may occur. Therefore, it is always wise to keep a fire watchers in the area for at least one hour after detonation. Sleeper fires have been known to hang over and spring to life because of the wind, fuel moisture or some other weather change long after work crews have left an area.

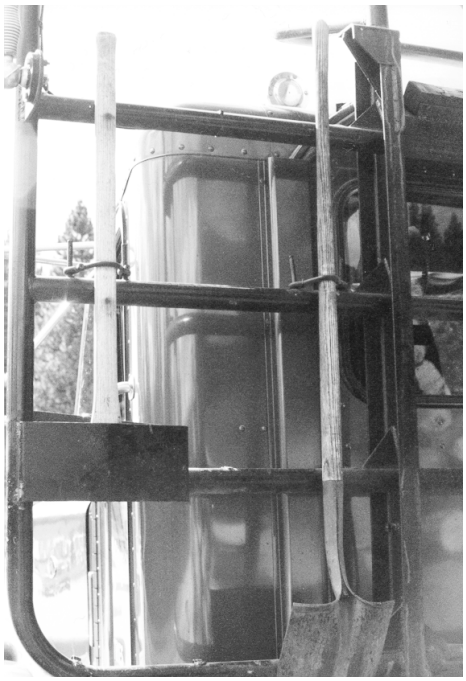
Federal Regulations 29 CFR 1926.900 (1) require the disposal of explosive containers by burning. Burning Permit and an approved site may be necessary for large construction projects.

Notes

Motor Vehicle Operation and Maintenance *8.0*

Motor vehicles (i.e., trucks, buses, pickups, passenger cars, etc.) are an integral part of every industrial operation in wildland areas. They also comprise one of the largest single fire risk associated with these operations. There are so many of these vehicles and they are used in so many ways that they pose an ever-present fire risk. Though perhaps concentrated in the operating area, this risk is not confined there. It is also present along access routes and in reconnaissance and exploration areas.

Any fire tools carried on motor vehicles should be readily accessible for quick use. They should never be locked inside of trunks, tool boxes or other compartments. Also, they should be retained and maintained for firefighting use only and never used for routine work.



I. FUEL SYSTEMS

Gasoline is highly volatile and easy to ignite. Diesel fuel has low volatility but will ignite if spilled on an exhaust manifold or exposed to a dead short of a battery cable. Carbureted gasoline and fuel-injected diesel engines use low-pressure fuel lines which, if cracked or broken, will allow fuel to spill or run out onto hot surfaces below the opening. Fuel-injected gasoline and external pump diesel engines employ high-pressure fuel lines which, if cracked or broken, will spray fuel all over the engine compartment, including onto exhaust manifolds. In rugged dirt road and off-road service, any of these things can easily happen.

The best means of preventing fires related to the fuel system is a good preventive maintenance program. The fuel system should be checked often for any signs of excessive vibration, cracks, abrasion or loose fittings. This is particularly important on those portions of any system that are above exhaust manifolds or pipes. Keep engine compartments clean and free of debris.

For quick suppression of these fires which may occur, each vehicle used as part of an industrial operation in the wildland should have, in addition to the wildland firefighting tools required by laws and contracts, a multipurpose dry-powder fire extinguisher of not less than four pound capacity. The extinguisher should be readily available to the operator without the necessity of unlocking a trunk or compartment to retrieve it.

II. EXHAUST SYSTEMS

Fires caused by vehicle exhaust systems are most often ignited by carbon particles or hot gases coming in contact with flammable vegetation (e.g., dry grass, leaves or needles) or by direct contact with such fuels by a hot metal part of the system (e.g., muffler, catalytic converter or exhaust pipe). The third way is for fuels (e.g., chaff, gasoline or paper) to come to rest on the exhaust manifold.

Internal combustion engines used in the wildland other than those providing power to licensed motor vehicles (except motorcycles) are required to be fitted with spark arresters. Many diesel and some gasoline engines are now turbocharged which usually substitutes for a spark arrester, but the others can still emit sparks.

A. Exhaust Carbon Or Particles

Internal combustion engines can burn fuel inefficiently and can produce carbon when idling, operating at low power or in poor condition. Subsequent revving of the engine associated with getting rolling or shifting gears (especially downshifting) or the application of full throttle will blow out any accumulated carbon particles, which are commonly at 1000-1200 degrees F. when they leave the exhaust system. They are very often still well above the ignition temperature of dry grass, leaves or needles (500-700 degrees F.) when they reach ground level. Some carbon particles actually are aflame while traveling through the air.

Operation of motor vehicles with sick or worn engines can produce carbon almost continuously. Pieces of it are likely to break lose and fly out the exhaust system at any time.

Carbon particles and hot gases can escape and start fires through cracks, breaks, burned or rusted out holes and loose connections. The entire exhaust system should be inspected at frequent intervals to make sure that none of these conditions exist.

B. Ignition By Direct Contact

Ignition by direct contact with hot metal parts of the exhaust system most often takes place at the muffler, catalytic converter or exhaust pipe between the manifold and the muffler or converter. Temperatures at any of these places are well above

the ignition temperature of dry wildland fuels. The time of greatest risk is during the first few minutes that a vehicle is parked, whether the engine is left running or not. Vehicles should be parked in an area cleared of all flammable material.

The hottest point on most exhaust systems under normal operating conditions is at the first bend behind the manifold where the pipe turns from a vertical to a horizontal alignment. If the engine is not kept properly tuned, raw gasoline will burn in the converter and produce temperatures as high as 2400°F.

Most catalytic converters are now shielded. Care needs to be taken that material does not become trapped between the shield and the converter, which could then cause a fire.

C. Catalytic Converter Melt Down

Most gasoline-powered motor vehicles today are equipped with a catalytic converter. Catalytic converters have been known to melt down and cause fires. The melting of the converter is caused by an initial malfunction in the electronic ignition systems which allows raw fuel to go directly into the exhaust system and accumulate at the catalytic converter causing the converter to melt and particles to escape the exhaust system.

Malfunctions of this nature can cause fires to be spread over a large area. The operator of the vehicle may not be aware that fires are being caused and continue traveling. Evidently, this malfunction can correct itself and the operator may never be aware of the fires that were caused by him/her.

D. Other Exhaust Problems

One other source of fires has been identified to be caused by wood chips after they have come into contact with the exhaust system.

It is believed that wood chips, when blown into a trailer while the truck is attached can enter the exhaust system. They can remain in the system and "cook" until they become light enough and are blown form the exhaust system, usually a distance from the operation area.

A second source of ignition from the wood chips is if they become lodged between the exhaust stack protector and the exhaust stack on trucks, again while being loaded at the operation area. These chips again "cook" from the heat of the exhaust stack and can fall out and cause a fire, usually a distance from the operation area. Additionally, in areas where there are dairies, manure can present the same problem as wood chips.

Fires from this source can be prevented by either having an extension on the exhaust stack turned 90 degrees from the trailer or by removing any obstructions in the heat shield which will allow the chips to fall through without being subjected to the heat of the exhaust stack.

III. ELECTRICAL SYSTEMS

Vehicle electrical systems can start fires in a number of ways. The most common is a short circuit in the wiring. This is usually the result of cracked, broken or abraded insulation. It can happen anywhere on the vehicle, not only in the ignition wiring. The best prevention is good preventive maintenance and prompt replacement of any wiring showing signs of age or wear.

Other electrical sources of ignition are short circuits in the starter or at the battery connections and cables and improper use of jumper cables. All of these cause arcing with the full voltage and amperage rating of the battery, thus intensive heat and sparking can occur.

IV. BRAKE SYSTEMS

Brake systems do not cause a large number of fires, but they should not be overlooked. Brake drums, shoes and discs can, and do, overheat if used excessively in mountainous terrain. The best way to avoid overheating brakes is to travel at reduced speed, assisting the brakes with engine compression, retarder or jake-brake as available.

Brakes can also cause fires when operators or service personnel spill flammable liquid on them while they are still hot after normal use. Although care in servicing should normally prevent such an occurrence, this is another reason why servicing, including emergency repairs, should only be done in an area cleared of all flammables for a distance of at least 10 feet in all directions.

V. MISCELLANEOUS

Fires can originate from overheated bearings, running on a flat tire, overheated engines and transmissions, etc. Motor vehicles involve a combination of machinery and people, either or both of which can fail at any time. When this happens in wildlands, a wildfire is very likely to result. So constant preventive effort is always needed.

VI. TOOL REQUIREMENTS

Because motor vehicles may cause wildfires, contract clauses and company rules may require firefighting tools to be carried on all vehicles used on industrial operations. The most common requirements are a shovel and an axe. Other requirements may be a five-gallon backpack pump and a four-pound or larger ABC rated fire extinguisher.

Use of Fire *9.0*

Fire is used in many ways and for various purposes related to industrial operations in the wildland. In some situations, it is a practical solution to a problem. In others, it is the worst possible alternative. In the eyes of some, it is a natural process and always preferable to the use of any herbicide. To others it poses an unacceptable threat of escape and destruction. In some cases, mechanical alternatives are available. In others, the only alternative is excessively expensive hand labor for collection and removal.

Fire is a very useful tool for the wildland fire management officer, land manager or construction contractor. It is also a very dangerous tool which should only be used by a well trained and experienced professional and with the full prior knowledge and permit approval of the responsible fire protection agency.

I. SLASH BURNING

Before any kind of burning can be done on commercial or private projects, local fire agencies need to issue appropriate burn permits and educate contractors or private land owners about air quality regulations and permits.

Logging slash is commonly burned for two reasons. One reason is to abate the greatly increased fire hazard of untreated slash. The other reason is to uncover the soil in preparation for planting or seeding to secure regeneration. Sometimes the slash is piled or windrowed before burning. On very steep slopes this pretreatment becomes very difficult and expensive and broadcast burns are more common.

No matter whether the slash is pretreated or broadcast burned, there is usually an abundance of cull logs, large limbs and other heavy fuel. Most often there is plenty of fine and medium fuel to ignite this heavy fuel, which then retains heat for very long periods. Rekindled and escaped fires after two to six months, even after heavy rains and snows, are not at all uncommon. One solution to this problem, which has been suggested, is yarding unmerchantable material (YUM logging) prior to burning. In the past this material really was unmerchantable, only the public agencies could afford to do it. With current energy needs and the interest in biomass fuel sources, this situation may very well change and cause YUM logging to be economically practical. If so, slash burning is bound to become a much safer operation.

Not all slash burning escapes result from holdovers in heavy fuels. Many of them are almost immediate and are generally the result of inadequate planning, preparation, staffing and/or execution. Logging slash creates a high intensity fire, which can easily escape by radiation, flying firebrands or convection.

Proper planning includes keeping the size of the burn area no larger than that which can be safely burned by the available staffing in one day. It also includes scheduling the burning of multiple areas over

several days or weeks so that too many are not touched off on any given day. In many areas, because of the short interval between the end of fire season and the onset of heavy rains and/or snow, this is not considered practical. Planning should also include the provision of alternate work for the burning crews on days when weather or other conditions make burning difficult, impossible or unwise.

Preparation for a burn should include construction of adequate control lines, pretreatment (e.g., crushing, lopping or spraying) and logistics (e.g., staffing, equipment, tools, ignition devices, water and food). It is not a simple or cheap undertaking. Staffing involves more than just someone to walk around with a fusee or drip torch. Adequate personnel should be present to keep the fire contained within its intended boundaries if it should flare up or make a sudden run. This includes detecting and suppressing spot fires outside the perimeter. In addition to firefighters, this will often require bulldozer or pump operators and other specialized personnel. Probably the most important position is an overall supervisor or prescribed fire manager to direct both the firing operation and any suppression action that may become necessary. The second most important staffing requirement is someone to patrol and, if necessary, mop up the burned plot until the fire is extinguished. This may extend into several months with daily patrols for hotspots. Prescribed burn plans may be required prior to burning.

Proper execution of a slash burn involves a thorough understanding of fire behavior, including the effects of topography, local wind patterns, fuel types and densities, etc. Generally, firing should proceed from uphill and downwind toward downhill and upwind. However, this pattern may have to be altered because of local conditions. In any event, firing should always be conducted so that no more heat is built up than can be safely contained by the standby suppression forces and so that smoke will not affect populated areas.

Where fuel loadings are particularly heavy or very strong or gusty winds are common, serious consideration should be given to

mechanical alternatives to slash burning. Several of these have been developed, especially for wildland use.

The Hydro Ax should be able to convert either slash or standing trees up to 16 inches in diameter into mulch of chips. Several brands of portable chippers will accept woody material up to four inches in diameter and blow the chips onto the forest floor. Other brush cutting machinery will chop material up into small pieces and mix them into the top layer of soil. Other machines which can effectively treat logging slash are either currently available or under development.

II. LAND MANAGEMENT BURNING

Fire is also extensively used as a land management tool. One of the most common of these uses is for cover type conversion (e.g., brush to forest or range). Another is to reduce fire hazard by removing dead material, brush or understory. Another is to favor one species or type of vegetation over another while not basically changing the cover type.

Some years ago the concept of burning in accordance with a prescription to achieve a specific goal on a particular site was developed in the South. In recent years prescribed burning has been accepted and is undergoing gradual development as a science. It involves a four-step process: (1) establishing the objective; (2) taking fuel inventories (i.e., amount, size, type, distribution, etc.); (3) establishing the intensity of fire needed to obtain the objective in the existing fuels; and (4) prescribing the range of weather factors that will produce the desired result on the type of topography where the site is located.

While writing the prescription requires knowledge and skill in the fields of fire physics and plant physiology, the execution of it demands similar knowledge and skill in fire behavior and meteorology. Firing too fast or too slow can negate the objective and potentially cause an escape. Precise knowledge of local weather

patterns is required to know when the prescribed conditions will exist, how long they will last and in what way they will change. The logistics involved can be complicated. Alternative work schedules should be available in case prescribed conditions for some reason do not develop on the day of the burn.

III. DEBRIS BURNING

In most mountains and valley areas, debris burning may be restricted by air pollution control laws. In a sense, slash and land management burning is debris burning, but they are generally allowed under the agricultural or forest management exemptions. Such exemptions are, however, in jeopardy if, in addition to fire safety, smoke production and drift are not properly managed. Burning of household trash may also be exempted in rural areas. However, the burning of industrial waste, including woody material resulting from clearing for construction projects, is usually not allowed unless the responsible fire protection agency certifies that the waste constitutes a fire hazard, which cannot be abated in some other way. The same is true for burning done for the sole purpose of fire hazard reduction, such as along highway or railroad right-of-ways.

Most fire agencies can help facilitate burning projects when the permittee complies with all fire safety provisions and makes some effort to reduce smoke emissions. For waste disposal, this can usually be accomplished by achieving complete combustion in a high intensity fire. A forced-draft air supply is usually necessary and several systems or pieces of equipment have been developed for this purpose. For fire hazard reduction, where the primary purpose is usually to eliminate the fine (flash) fuels, both smoke emission reduction and the objective can best be obtained by following a prescription that produces a low intensity fire. This kind of fire will also be reasonably safe from escapes.

IV. LUNCH AND WARMING FIRES

Lunch and warming fires should be kept no larger than needed to do the cooking or provide warmth. They should have a clearing to mineral soil for at least five feet in all directions from the perimeter of the fire. The fire should be confined to a depression scooped in the center of the clearing. At least one adult should be in attendance with firefighting tools (i.e., shovel, backpack pump and axe) readily available until the fire is completely extinguished. Extinguishment should be with water and checked by bare hand.

Under weather conditions creating “high” to “extreme” fire danger, which indicates the probability of high winds or burning conditions, the use of lunch or warming fires should be prohibited. Since the workers may not be aware of these conditions, it is the responsibility of the company management to inform them and enforce the restrictions. Lunch and warming fires should only be used under the terms of a permit or authorization issued by the appropriate fire agency and, if on private land, by the owner.

V. INFRARED SCANNING

Infrared scanners can detect concentrations of heat, which are not visible to the human eye (e.g., no smoke, area obscured by smoke or darkness).

Infrared scanners come in various models. The most useful to public or private fire specialists are those designed for mounting in aircraft and those that are hand held. In an aircraft (fixed-wing or helicopter), large areas can be checked quickly for holdovers from slash or land management burning or abandoned lunch and warming fires. The handheld scanners are useful for checking specific suspected locations (e.g., recently extinguished lunch and warming fires, previously burned piles or windrows of slash, or areas near the control lines of wild or prescribed fires).

Timber Harvesting *10.0*

Historically, the timber harvesting industry has been responsible for fires, including some of the most devastating and costly in American history. Over the years, the record has been significantly improved. Considering the fact that the timber industry is operating continuously in a highly vulnerable environment, timber harvesting operations cause remarkably few wildfires. Industry personnel suppress most of those fires before the public agency forces arrive. This kind of record cannot, however, be maintained without continuous effort on the part of both the industry and the fire agencies.

With only a few exceptions, fires caused by timber harvesting operations are the result of ignorance or carelessness. The fully informed and conscientious operator or employee will not willfully risk a fire. Too much is at stake. On the other hand, new or poorly trained employees can unknowingly cause fires.

This section will present some of the more important fire safety information for the timber harvesting industry. Included is material on machinery, procedure, personal habits and special areas.

I. CHAIN SAWS

In the past, chain saws were among the most dangerous machinery in the woods. A modern saw in the hands of a skilled operator will seldom cause a fire. Many older saws were poorly designed and underpowered. Unfortunately, some of them are still around. Design features included discharging the exhaust into the saw cut or sawdust, fuel filler cap directly above the exhaust system, lack of or poorly designed spark arresters, etc. Underpowering led to overheating. In the past, saw operators were either not trained or were not required to refuel in cleared areas, keep spark arresters clean and in place or carry firefighting tools and equipment.

The greatest fire danger with regard to a chain saw is during refueling. The saw should always be set firmly in position within an area cleared of all flammables down to mineral soil for a radius of 10 feet. The engine should be stopped and allowed to cool while chain oil is being replenished. The required fire tools (i.e., shovel and fire extinguisher) should be placed nearby. Care should be exercised to avoid spilling any fuel on the engine, especially on or near the exhaust port.

A dangerous operation with the chain saw is cutting dead wood. Unless decomposition has started, the wood is harder than green wood; therefore, the saw has to work harder and both the chain and the engine can overheat. In addition, the sawdust is a highly flammable fine-sized fuel. It can quickly blow onto the engine and ignite. It will not necessarily stay there. Before the operator even notices it, glowing embers can fall into sawdust or duff. The sharper the operator keeps his chain the easier it will cut; therefore, less heating of both chain and motor will result. If the surface wood is punky, even the exhaust gases

can ignite it. A careful fire watch should be kept on such an area for at least one hour following cutting.

The spark arrester should be checked for holes each time the saw is refueled. If the mesh is fine enough to meet legal standards (.023 in.), screen arresters work quite well when both they and the engine are new. Worn engines produce more carbon than new ones, therefore, they tend to clog the screen rather rapidly. The wire used to make the screen, though usually a high carbon steel, is so fine that it will burn out under continuous heavy use. Thus, in order to avoid either excessive back pressure or the escape of carbon particles, these screen arresters require frequent inspection and servicing. They should be inspected for holes at each refueling and cleaned daily. Most professional sawyers carry a spare spark arrester screen to avoid costly shutdown if the installed screen should fail.

II. TRACTORS, SKIDDERS, LOADERS, ETC.

The heavy power equipment used in timber harvesting is not basically different from that used by the construction and surface mining industries. Generally speaking, however, the hazards are greater since the logging machines are operating almost continuously over and through flammable wildland fuels. Construction and mining equipment, on the other hand, is usually working in the hazardous environment only during the pioneering stages of a project or operation. Consequently manufacturers, distributors, owners, and agency inspectors have all devoted a great deal of attention to the reduction of the fire-starting potential of logging machines.

Exhaust sparks may be a fire risk from logging machinery. This explains the requirement in laws and timber sale contracts for spark arresters on all exhaust stacks, not only the main engine, but starting and other auxiliary internal combustion engines as well. Because the

rapidly turning drive blades of a turbocharger tend to chew carbon particles into dust and thus act as an attrition spark arrester such

turbochargers are usually accepted in lieu of spark arresters. This practice should not be followed automatically. The exhaust systems on certain makes and models of engines are so designed that only a portion of the exhaust gases pass through the turbocharger, the rest being bypassed directly into the exhaust stack and thus receiving no spark arresting treatment. These machines, even though turbocharged, must be equipped with spark arresters.

An adequate spark arrester is one that effectively removes carbon (sparks) that are large enough to ignite light fuels (e.g., dry grass, pine needles or oak leaves) from the exhaust stream. It will only do this if it is of the proper size and is properly installed (i.e., vertical or horizontal). Most all arresters in use are of the retention type. This means that they trap and retain carbon particles. When the trap becomes full, they completely lose their arresting capabilities, and thus no longer comply with legal or contract requirements. Therefore, the trap should be emptied regularly and often. The spark arrester on a finely tuned machine should be cleaned every 30-40 operating hours. The proper way of doing this is to park the machine on a landing or other large cleared area, remove the band or plug, start the engine and rev it up to blow out the carbon, shut down the engine and replace the band or plug. It should be remembered that some units may require two spark arresters: one for the diesel engine and one for the gasoline starter engine.

OSHA regulations require most new equipment to be fitted with mufflers or silencers. Many older operators and owners are convinced that an internal combustion engine cannot operate efficiently with both a muffler and a spark arrester affixed to the exhaust stack because too much back pressure is created. This is not necessarily so, provided the proper model and size of both is utilized. Many new machines come

factory equipped this way and older machines can be successfully retrofitted if properly engineered.

Another fire risk, particularly with log skidding equipment (e.g., tractors and rubber-tired skidders), is the collection of flammable debris inside the engine compartment, particularly on the exhaust manifold or in the belly pan. The danger of the former location is obvious. Debris in the belly pan restricts cooling of crankcase oil, hydraulic fluid and engine cooling water and causes engine overheating. In addition, it forms a fuel bed to which access for extinguishment of a fire ignited from any source (e.g., exhaust sparks, flaming or glowing material falling from the exhaust manifold or electric short) is almost impossible. For both reasons, machines designed for use in the logging industry by all manufacturers in recent years have had the engine compartments enclosed by plates and/or screens. These should always be kept in place while the machine is being operated. Some operators and mechanics fail to replace them after servicing or repairing equipment, but they are creating more problems than they are solving when they do this. In fact, it would be good practice to retrofit older machines with these screens. Those machines which are not so equipped should have all debris removed from the engine compartment, especially the belly pan, regularly and often. Once a day or at every refueling is recommended.

Another potential source of ignition of flammables located either on or off of the machine is leakage in the exhaust system. This problem is primarily one of inadequate maintenance and repair. Leaks can develop from cracks, missing bolts, burned-out or rusted-out spots, etc. Also some exhaust systems include sections of flexible tubing. These are vulnerable to vibration and burning out. They should be checked regularly for leaks. Any exhaust system which leaks is in violation of the spark arrester laws and regulations.

A source of fire ignition can be an electrical short. All such equipment has an electrical system, either for ignition on a gasoline-starter engine or for power supply to an electric-starter motor. The cables are subject

to abrasion, vibration and corrosion and thus to shorts. The resulting arcing will most often ignite a fire on the machine itself, particularly if it has been allowed to accumulate flammable debris and/or oil or grease. Once the machine catches fire, it becomes a threat to the surrounding forest. Therefore, electrical systems should be checked frequently for any signs of worn insulation, loose connections or corrosion. Also, the entire machine, not just the belly pan, should be kept clean of flammable debris. As an additional safeguard, it has been suggested that a quick-operating master switch for opening the circuit be located within easy reach of the driver for use in an emergency. Similar protection could be provided by an automatic overload circuit breaker.

Less frequent causes of fires in logging machinery include: overheated brakes on wheeled equipment, slipping belts, overheated bearings and bushings, sparks struck by bulldozer tracks or blades against stones, etc. Most of these, except the last, can be avoided by good preventive maintenance programs, which will not only make the equipment more fire safe, but also improve its efficiency and longevity. Blade and track sparks are difficult to prevent, thus require vigilance and rapid suppression action.

Every piece of mobile equipment used for yarding and loading logs should be equipped with a readily accessible fire extinguisher and should be required to have a long-handle, round-point shovel for fire suppression. The extinguisher should be at least a 10-pound multipurpose (ABC) dry-powder type. All extinguishers and tools must be in compliance with regulations.

III. FELLER/HYDRO BUNCHERS

Another process is the use of machinery that cuts and bunches smaller trees for processing into wood chips either for pulp or hog fuel. These machines are normally referred to as “feller/bunchers.” Although all of the machines pose the same risks of fires from the exhaust system, these type of machines bring their own unique fire risk problems. Numerous fires have been documented from these types of machines with a saw, instead of a snipper. The saw causes a fire either

through friction of cutting the tree off or the saws teeth hitting a rock unseen by the operator. Due to the high hydraulic pressure these machines operate under, fires can readily ignite when a leak occurs in the hydraulic system and comes into contact with the hot exhaust or engine.

Another type of ignition is the saw contacting rocks throwing sparks into the dry vegetation.

Because the weight of most mechanized harvesting equipment is less than some conventional types of equipment, they can pivot and turn quicker than a bulldozer, thus creating sparks from the cleats when contacting rocks. When these sparks land in a receptive fuel bed, an ignition can occur.

IV. MANUAL/AUTOMATIC FIRE SUPPRESSION SYSTEMS

Many models of heavy equipment have these dry chemical fire suppression systems which are mounted inside the engine compartment and should be inspected. There are three parts to the system: the firing mechanism, extinguisher, and the distribution system.

The firing mechanism consists of a nitrogen cartridge that can be visually checked for a manufacturing date stamped on the neck. If the date is over ten years old, the cartridge needs to be replaced. Also check wiring to the cartridge for any frays and also check for tight mounting brackets.

When inspecting the extinguisher, the top lid can be removed and the dry chemical stirred to check for wetness or clumping, the chemical must be dry and loose to be effective. In accordance with NFPA Standard 17, the chemical must be replaced every six years. Also inspect brackets for tightness.

The distribution network begins at the extinguisher outlet and ends at the nozzles. The following are items to check:

- Check for hoses routed out of the way of all engine compartment parts. The hoses should be secured with connectors and hose tie wraps.

- Look for hose kinks and damaged hose.

- Where hose or pipe runs through metal there must be a rubber grommet in the hole.

- All nozzles must be aimed at hazard areas and the hinge on the cone nozzle cap must be mounted away from the hazard areas.

- There must be spring tension in nozzle caps (not all models have caps) and no debris accumulations on cone caps.

- The battery wiring to the extinguishing system should be checked for flaws.

V. CABLE SYSTEMS

Cable logging systems are composed of yarders, cables and usually blocks. They are rigged in three basic configurations (ground lead, high lead and skyline) with many variations of each. Their primary use is for logging country, which is too steep for skidder or tractor logging. This means that they are found in topography where fire suppression is very difficult and expensive. Therefore, fire prevention is of utmost importance.

The yarder is generally speaking, the least dangerous part of a cable logging system from a fire risk standpoint, but it cannot be ignored. A yarder is composed of an internal combustion engine providing power to a winch with one to four drums and a boom or tower. In some systems, the tower is separate. Even though the yarder normally operates in a semipermanent location (e.g., a landing) which is

relatively free of flammable vegetation, the exhaust system is dangerous and is required to be spark arrester equipped. The same recommendations for cleanliness and preventive maintenance apply to this piece of mechanical equipment as to any other. Some special areas where excessive friction can cause fires are the cable drum brakes and the blocks or sheaves on the boom or tower. Fire extinguishers and firefighting tools should be required on or close to the yarder.

The cable, being made of steel and, except for a standing skyline, traveling at high rates of speed, can create very high frictional heat in anything it rubs against. On live green vegetation this will normally not cause a fire. However, many wildfires have been observed to have been started by cables rubbing against dead woody material, including standing snags, down logs or trees, stumps, dead branches on live trees, etc. Therefore, it is of the utmost importance that all moving cables be laid out and rigged in such a way as to avoid contact with dead woody material at all times during setup and use.

A special problem is presented by skylines and, to a lesser extent, high leads. This is not from the potential for starting fires, but from the flying hazards to firefighting aircraft. There have been several near misses by both fixed wing planes and helicopters. Therefore, whenever a fire is known to be in progress on the operating area or nearby, skylines should be lowered to the ground and high lead systems allowed to go slack. Telescoping or hinged towers and booms should also be lowered until it is certain that low-flying aircraft will no longer be in the area.

Skyline cable systems having motorized carriages must be inspected for spark arresters. There is not a great fire risk here, but as with any internal combustion engine, it will require an arrester. Some carriages may be equipped with manual/automatic fire suppression systems in the event of a malfunction that causes the carriage to strike the ground. Since these carriages will have a fuel supply (although not large) and a battery, the intent of the fire suppression system is to activate upon impact and extinguish a fire caused by sparks and fuel.

These extinguishing systems are not 100% dependable in carriage or sky cars, but are an attempt by industry to prevent fires. When inspecting carriages, the fire suppression systems are the same as are found in heavy ground equipment.

The most fire-hazardous parts of a cable logging system are the blocks. Depending on their position and purpose, these may be known as tail blocks, haul-back blocks, corner blocks, etc. So many fires have started at blocks that protection agencies have special regulations regarding them and many timberland owners have special timber sale contract clauses about them. Common causes of fires at cable blocks are frozen bearings, dead wood jammed between the cable and the block and the block resting on flammables. The most common requirements are for a clearing to mineral soil for a radius of 15 feet in diameter from a point directly below the block and the placing of firefighting equipment (usually a shovel and a backpump or fire extinguisher) nearby.

VI. CHOKER SETTING

Although they seldom use machinery, choker setters, like fallers, limbers and buckers, are often working alone, more or less isolated and difficult to supervise. They work in areas where fires are most difficult to fight, away from roads with logs and slash on the ground. In addition, they are generally less skilled and tend to be younger than other woods workers. Some do not realize the fire risk they represent.

Although many companies prohibit smoking on their operating areas and various laws impose penalties for smoking at certain times and places or for discarding burning tobacco or matches, the only effective enforcement in isolated work situations is self-discipline.

VII. HELICOPTER LOGGING

The equipment used in helicopter logging is not inherently any more dangerous from a fire standpoint than that used in any other logging system and less than some. There are, however, two matters of some concern: refueling and accessibility for fire suppression.. Very large helicopters needed to lift the heavy loads are powered by turbine engines and thus use much less volatile fuel than gasoline engines. Still large quantities of the fuel must be stored and transferred at heliports on or near the operating area. Special precautions should, therefore, be taken to contain spills and to combat petroleum fires. This is accomplished by burying or blocking tanks and building dikes around the tanks.

Fire Extinguishers requirements for helicopter refueling:

A. Aircraft refuelers :

1. Must be equipped with at least 2 fire extinguishers having a minimum rating of 20-B:C (U.F.C. Standard No. 10-1)

2. A fire extinguisher must be readily accessible from either side of vehicle.

3. Portable fire extinguishers at aircraft motor vehicle fuel dispensing stations shall be located such that pumps and dispensers are not more than 75 feet from one such extinguisher.

B. Open hose discharge capacity for fueling system less than 200 gallons per minute:

At least 2 fire extinguishers minimum rating of 20-B:C (U.F.C. Standard No. 10-1).

C. Open hose discharge capacity for fueling system more than 200 gallons per minute but not over 350 gallons per minute:

At least one wheeled extinguisher having a minimum rating of 80-B:C (U.F.C. Standard No.10-1) and having a minimum capacity of 125 lbs. Of agent shall be provided.

D. Open hose discharge capacity for fueling system more than 350 gallons per minute:

At least 2 wheeled extinguishers having a minimum rating of 80-B:C (U.F.C. Standard No.10-1) and having a minimum capacity of 125 lbs. Of agent shall be provided.

The other fire problem associated with helicopter logging is accessibility for fire suppression. Because of the economics involved, helicopter logging is seldom used where cable, tractor or skidder yarding can be done. Therefore, large portions of the operating area are accessible only by air or on foot and the rugged terrain promotes rapid spread and difficult control of any fires. Fallers, limbers, buckers, choker setters or rigging slingers are working in semi-isolation and with minimum supervision and communications. Their capacity for initial attack fire control is limited. The only feasible means of fire response by protection agencies is by helicopter; foot travel is much too slow. A water tank and bucket may be required by some agencies and private timber sales and be available at the landing.

Extreme caution must be exercised in approaching fires by helicopter under such circumstances to avoid scattering the fire with the downdraft of the rotor blades.

VIII. LANDINGS

It would be easy to consider log landings as fireproof as they are often carved out of a hillside and/or located on bare soil. They are, however, seldom any larger than necessary to perform the yarding

and loading operations and, thus, are closely surrounded by flammable vegetation. In addition, they have a tendency to quickly accumulate trash and debris including bark, limbs, paper, oil, etc. It is, therefore, necessary to maintain suitable fire prevention and suppression defenses. These include properly serviced spark arresters on all internal combustion engines, clearance of flammables, fire tools, fire extinguishers, horn (or other alarm system), smoking rules, etc. Landings are used by crews for lunch or warming fires. Wildfires occur when these fires go unchecked. Landings are ideal locations for weekend recreationists to park or camp. Patrol should be considered in these areas.

IX. TIMBER COOPERATORS

In some areas large timber land owners and operators have formed fire protection cooperatives or associations. The purpose of these cooperatives is to implement and coordinate the use of industrial manpower and equipment to fight wildland fire and to provide liaison between industrial and public control forces. These groups provide a service of great value to both their members and the public agencies at a very nominal cost of a few cents per acre or per thousand board feet of timber harvested per year. Almost the only expense is salary, transportation and communications for a seasonal employee. In both cases, they hire a forester/firefighter. This individual collects copies of all timber operator fire plans in his/her area, attends industry/agency meetings, assists in training and physical testing, assists agency dispatch in ordering, assigning and demobilizing industry forces during fires, etc.

The following is a typical duty statement for an Industry-Agency Liaison position:

A. Pre-Season Activities

1. Attend annual spring industry-agency and air patrol meetings.

2. Promote and help conduct employee fire training and physical testing.

B. Inventories

1. Prepare and maintain records of available equipment and personnel.

2. Coordinate preseason equipment qualifying inspections.

3. Keep current on changes in operating areas.

4. Coordinate private aerial fire patrol with agency patrols.

C. Ordering Forces

Function as an integral part of agency dispatching system when industry personnel and equipment are required for emergency firefighting.

D. During Fire Operations

1. Fills Industry Liaison position in fire line organization.

2. Coordinates relief, equipment use, welfare, etc., for industry forces.

3. Assists agency in rotating forces, obtaining replacements and attempting to share the burden of the fire equally among operators.

4. Inform or alert the agency and/or operator as to any potential problems developing.

E. Demobilization

1. Assists agency in establishing priorities of release of industry personnel and equipment.

2. Assists in coordinating transportation of industry personnel and equipment.

Although this type of organization is particularly suited to large timber landowners, it is adaptable to other large landowners (e.g., range) and large construction or mining companies that expect to be in one location for a relatively long time.

X. ON-SITE FIREFIGHTING EQUIPMENT RECOMMENDATIONS

As set forth in the section on Fire Plans, a rather comprehensive set of standards for provision of firefighting equipment on timber operating areas has been worked out over a period of years. Although minor differences exist between regulations of various agencies and between different timber sale contracts.

Notes

Construction and Surface Mining *11.0*

Construction and surface mining are treated together because, although each has certain operations and equipment unique to itself, they generally involve similar operations (e.g., earth moving, drilling and blasting) and equipment (e.g., bulldozers, loaders and air compressors). Construction includes building dams, highways, railroads, pipelines power lines, etc., as well as grading for real estate developments, realigning or widening highways, etc. Surface mining includes rock and stone quarries, sand and gravel pits, cement quarries, as well as mines for specific ores such as iron, coal, borax, diatomaceous earth, etc.

The time of greatest fire danger in any of these activities is during the pioneering or right-of-way clearing phase. At this time, people and machines are working in and among vegetative fuels which may be highly flammable during a major portion of the year.

When earth is moved, much of the operation takes place on bare mineral soil or rock. However, even then fire prevention activities and fire suppression readiness cannot be ignored. There is always a fringe or border zone where vegetation meets the working area and there are always access routes. The latter are particularly important because a major portion of wildland fires associated with construction and mining start along such access routes from motor vehicles and/or their operators.

I. EARTH MOVING EQUIPMENT

Earth moving equipment (e.g., bulldozers, scrapers, end loaders and trenchers) comprises the majority of construction and surface mining equipment and also the bulk of the fire risk in these activities. This section applies equally, however, to all other mobile equipment used in these industries (e.g., pavement spreaders and rollers, fork lifts, sidebooms and compactors). All these types of equipment are powered by internal combustion engines and are, therefore, required to be fitted with a properly functioning spark arrester when operating on forest, brush or grass-covered land.

"Operating on" has been interpreted as meaning either actually on and over these vegetative fuels or in proximity thereto. Almost any place on a highway, power line or pipeline right-of-way would be included as would all areas within 50 to 100 feet inside the perimeter of open pit mines or quarries or dam site clearings or anywhere outside such perimeters.

A "properly functioning spark arrester" normally includes a turbocharger, providing none of the exhaust gases are allowed to bypass the impeller blades. If the arrester is of the common trap type, it is only "properly functioning" if the carbon trap is empty enough to actually trap carbon particles. The frequency of cleaning the trap to meet this standard will vary with type and condition of engines and type and amount of use. Generally, however, spark arrester traps should be emptied no less often than once a week. A well-tuned engine operating continuously at or near full power will usually produce the fewest exhaust carbon particles. An engine that is in poor condition and is allowed to idle for an appreciable time will, when revved up, produce large quantities of carbon particles. Most equipment is operated and maintained somewhere between these two extremes.

The escape of carbon particles out of the top of the stack is the most frequent source of wildland fire from the use of these machines; although other parts of the exhaust system can, and sometimes do, provide ignition sources. These primarily include leaks and

accumulations of flammable debris. During any routine maintenance, the entire exhaust system from manifold to end of stack should be inspected for cracks, burned out holes, missing bolts, broken gaskets, etc., and for accumulations of debris. Appropriate corrections must be made. A leaking exhaust system may be in violation of spark arrester laws and regulations.

Other sources of ignition from these machines include sparks from blades or tracks scraping against rocks, overheated brakes on wheeled equipment, friction from worn or misaligned belts and drive chains and burned out bearings or brushings. The first of these is hard to prevent, but operators should be aware that sparks can, and do, fly from rock/metal contact and they should be prepared and equipped to take immediate suppression action. The others result primarily from inadequate maintenance and the prevention indicated is fairly obvious.

A common fuel bed, which presents a fire hazard to both the machine and the surrounding vegetation, is accumulated debris in the belly pan. Such debris, even though often including soil, is usually soaked with oil and, therefore, even more flammable than when in its natural state. Besides being a fire hazard, it also restricts air flow around the crankcase and causes overheating of lubricating oil. Two remedies are available: screening the debris out of the engine compartment and washing or blowing the debris out during servicing and maintenance. This trash problem has been so serious in the logging industry that all major manufacturers now equip their new logging machines with screens or grates to completely enclose the engine compartment. In the interest of fire safety, all owners and operators in any type of service should have their machines similarly equipped.

All such equipment has an electrical system, either for direct starting or for ignition on a gasoline starting motor. These electrical systems occasionally develop shorts and electric arcing which often ignites a fire. It has been suggested that all machines, both new and old, be equipped with a conveniently located master switch by which the operator can instantly open the circuit to stop any arcing. An alternative would be an automatic overload circuit breaker.

All construction equipment, whether tracked or wheeled, and whether for highway or non-highway use, should be equipped with a shovel and a fire extinguisher. Both should be mounted so as to be readily available to the operator in case of fire, not locked away in a compartment or trunk. The shovel should be long-handled and round-pointed. The extinguisher should be multipurpose (ABC), four pounds or larger. Some of the large and expensive machines may be equipped with manual/automatic fire suppression systems.

II. STATIONARY AND PORTABLE EQUIPMENT

Under this heading is discussed equipment which may be mounted on wheels, tracks or skids, is usually not self-propelled and is normally operated in a given location for an appreciable time, from a few hours to several months. Such equipment can be highly varied but is typified by air compressors, chippers, generators, derricks or cranes (other than electric), etc.

As with all internal combustion engine-powered equipment, the greatest fire danger comes from the exhaust system. The problems and their solutions for this type of equipment are somewhat different than for mobile equipment. It is often governed to run at a steady speed, but not necessarily at a steady load. Being in a fixed location, grass can grow up under and around it and leaves and needles can blow against it even though it may have been placed on bare ground at the outset. This machinery would usually be in the way if placed directly in the operating area.

Over the years, various laws, ordinances and regulations have been adopted regarding such equipment. They should require the same type of exhaust spark arresters as for mobile equipment, a clearance of all flammable materials of at least 10 feet in all directions from the machine and the provision of a shovel and a backpack pump water fire extinguisher in the immediate area. It is good fire safe practice to inspect the exhaust system on these machines periodically for leaks as discussed in “Earth Moving Equipment.”

III. TRENCHING EQUIPMENT

A modern piece of equipment being used to trench through rock is a rock saw. This piece of equipment requires a 10 foot clearance like any other grinding equipment. Due to the terrain that this equipment is used in, often a 10 foot clearance is unattainable. In this case, a water tender of 2000 gallons may be required to be on site and saturate the area prior to operating.

IV. SMALL MULTIPOSITION ENGINES

These engines power all types of hand held power equipment, including chain or rotary saws, posthole diggers, weed cutters, compactors, etc. These engines must be equipped with spark arresters like all other internal combustion engines used on forest, brush or grass-covered land. The retention or attrition arresters and turbochargers commonly used on larger engines are too bulky and heavy for these hand held engines. Therefore, they are commonly fitted with screen-type spark arresters. If the mesh is fine enough to meet legal standards (.023 in.), screen arresters work quite well when both they and the engine are new. Worn engines produce more carbon than new ones; therefore, they tend to clog the screen rather rapidly. The wire used to make the screen, though usually high carbon steel, is necessarily so fine that it will burn out under continuous heavy use. Thus, in order to avoid either excessive back pressure or the escape of carbon particles, these screen arresters require frequent inspection and servicing. They should be inspected for holes at each refueling and cleaned daily.

Probably the most hazardous time in the use of these small engines is during refueling. Since they are built very compactly and most all use gasoline for fuel, the proximity of the gas tank filler opening to the exhaust outlet and other very hot engine parts makes it easy to spill gasoline in a place where it will burst into flame. Therefore, the same laws and rules are applicable to all these machines as to chain saws discussed under “Timber Harvesting.” Basically, these laws and rules include having firefighting equipment readily at hand, refueling

only in an area cleared to mineral earth for at least 10 feet in all directions and, when restarting the engine, to move it away from any fumes and turn it so the exhaust points away from the refueling location.

Another source of fire from these machines is the cutting edge, or other rapidly moving metal part, striking a rock and causing a spark. This has been a fairly frequent occurrence with rotary mowers used to clear dry grass and weeds. It can happen with any of the types of machines discussed here. Whether a fire starts from this cause, from exhaust sparks or from fuel spillage during refueling, it is imperative that the operator be prepared to immediately shut down the machine and commence fighting the fire. This is why it is important to have the required firefighting tools kept within 25 feet of operation and refueling.

V. CRUSHERS AND PAVEMENT PLANTS

These plants are usually erected on large areas of bare soil, sand or rock and are thus not, in themselves, wildland fire risks. The greatest source of fire danger around the plants is the people and other machines that work in and around them; the most frequent location of fire starts is along the access routes. People smoke and sometimes build lunch or warming fires. Motor vehicles and other mobile equipment emit exhaust sparks, have electric shorts, develop fuel leaks, etc. Thus, even though the plants themselves are not great fire risks, their existence creates an increased fire risk in the area and warrants extra fire prevention effort.

VI. SERVICING AND MAINTENANCE OF EQUIPMENT

For a more complete treatment of this subject, please refer to the chapter on “Maintenance, Repair and Servicing.” The most important points to remember are: whenever possible bring equipment to a service area which is free of flammables; if the machine cannot be moved, clear all flammables to mineral soil for at

least 10 feet in all directions from it; in any case, always have firefighting equipment available nearby (i.e., within 25 feet); and have spark arresters on all internal combustion engines.

VII. TRAINING

Construction and mining employees are less likely to have had previous training and experience in fighting wildland fire than loggers. Therefore, for their own protection, as well as their employer's, it is important that they be given at least minimum training in wildland fire control.

Notes

Well Drilling and Operating *12.0*

Fires resulting from well drilling or operation can cause considerable damage and are very difficult to suppress. The greatest hazard is associated with petroleum and gas wells because of the expected presence of methane and/or hydrogen sulfide gas, both highly flammable. Other deep drilling (e.g., geothermal or water) can also produce such flammable gases.

I. REQUIREMENTS

Laws can apply to drilling rigs as any other machine operated on forest-covered, brush-covered or grass-covered land (i.e., all internal combustion engines, except muffler-equipped highway licensed vehicles, should be equipped with an effective spark arrester; in addition, all such machines operating in a fixed location must have a clearing of all flammable materials of at least 10 feet in all directions). For oil and gas drilling, this is hardly enough. Consequently, many local ordinances and company rules call for much more.

Among the more common requirements are water-cooled exhaust systems, explosion-proof lights, smoking prohibition, provision of fire extinguishers, additional clearance of flammables, "fire watch" during welding and cutting or welding only under special short-term permit.

II. RISK

Historically, the greatest wildland fire risk associated with well drilling has been welding and grinding. If there is any possibility of the presence of methane, hydrogen sulfide or any other flammable gas, no welding should be done within 50 feet of the wellhead. In any event, no welding should be done without first clearing all flammable vegetation down to mineral soil for a radius of at least 10 feet from the location where the welding is to be done and having a five-gallon backpump and a shovel within 25 feet of the operation.

A fire problem associated with the operation of wells is the direct ignition of dry grass or leaves by high temperatures from steam lines laid on the surface of the ground. These pipes may be either for recharging oil wells or for collecting geothermal steam for a power plant. Any of three solutions seems to be satisfactory: to bury the pipe, to insulate it or to treat the soil for a foot or two on each side of it with a proper herbicide or soil sterilant.

Commercial Transportation and Storage *13.0*

Commercial transportation, largely by truck, is a large industry in many wildland areas. Supplies and consumer products are delivered, raw materials taken to processing plants and finished products hauled to markets. Most of the commodities represent little or no fire hazard; some are very dangerous. The vehicles used represent one of the highest fire risks present in the wildlands (see the chapter on Motor Vehicle Operation and Maintenance). Some of the operators of the vehicles are also serious fire risks (i.e., smoking and driving habits, lack of knowledge regarding cargoes and firefighting, etc.). Associated with much of the transportation activity are storage and distribution facilities (e.g., warehouse, bulk petroleum plants, explosives magazines, or LPG distributors). Some of the products involved and their chemical or physical properties related to fire are unknown to local firefighters. Often, bills of lading do not provide adequate information to either the driver or firefighters about the nature of the cargo.

I. HAZARDS

There are three major kinds of hazards to be aware of and protected against: violent rupture potential, explosive and toxic. The smoke or fumes of any of these should be avoided or protected against with a self-contained breathing apparatus and/or protective clothing. Loads containing more than 100 pounds of a hazardous material (some types 1000 pounds) are required to be identified with placards. The placards are diamond-shaped and of various colors. The categories are: explosives, gases (flammable and non-flammable), flammable liquids (and combustible liquids [US]), flammable solids, oxidizers, and organic peroxides, toxic (poison) materials and infectious substances, radioactive materials, corrosives, and miscellaneous dangerous goods.

A. All flammable gases have violent rupture potential (VRP). Some are also toxic (e.g., carbon monoxide, hydrogen sulfide and vinyl chloride). Flammable gases commonly transported in wildland areas include liquefied petroleum gas (LPG), propane and vinyl chloride. Any of them will usually ignite if a rupture or serious leak in the container occurs. If not, it will form a gas cloud that is easily ignited. The proper fire suppression technique is to stop the flow of gas by closing a valve. If this not possible, allow the gas to completely burn while keeping the container cool with water. Tanks containing flammable gases that are exposed to intense heat are likely to rupture violently and engulf the immediate area in a large fireball. When tanks are thus exposed, consider initial downwind evacuation for at least one-half mile.

   The most fire-hazardous operation with LPG is during and immediately following transfer from one tank to another. Transfers occur at bulk plants, both incoming and outgoing, and at points of use, residential and commercial. This operation takes place thousands of times each day because LPG is so widely used outside of metropolitan areas served by natural gas. Leaks can happen from cracked, broken or poorly

connected fittings, ruptured hoses and human error, such as failing to disconnect before driving away. Ignitions can occur from any of a number of sources, which may or may not be associated with the transfer operation itself since escaping gas will travel and often find a heat source.

B. Another fire hazard with LPG is the threat of overheating and rupture of containers, pipes and fittings by wildfires. All LPG containers, whether at bulk plants or at points of use, should be well protected from this danger by adequate clearance or dry grass, brush and unlimbed trees for at least 10 feet in all directions. They should also be separated from each other and from buildings depending on their size: less than 100 gallons is five feet, 100-500 gallons is 10 feet, 500-1200 gallons is 25 feet and over 1200 gallons is 50 feet.

II. HAZARD CHARACTERISTICS

A. There are three groups of explosives: primary or initiating high explosives, secondary high explosives and low explosives. Primary or initiating high explosives are easily detonated by applying small amounts of heat, mechanical shock or pressure. Their chief function is to initiate detonations in secondary high explosives. The major ingredients in primary explosives include, but are not limited to, lead azide, lead styphnate, and mercury fulminate. Electric blasting caps and detonating cord delay connectors are both examples of primary high explosives.

B. Poisons are also divided into two categories, A and B. All are very toxic and many have VRP. Poisons A are gases and are extremely toxic. They must be avoided by all personnel except specialists with protective clothing and breathing apparatus. If leaking, personnel should be evacuated as far as necessary to avoid any contact. Examples of these materials include nitric oxide, parathion gas (VRP), organic phosphates and phosgene (VRP). Poisons B are mostly liquids or solids. Continued

contact, inhalation or ingestion can cause illness or death. Try to prevent spread by constructing dikes, berms or dams. Examples include cyanide (dry), parathion (liquid or dry), tetraethyl lead (VRP) and chlorine (VRP).

C. Flammable liquids (placarded "Flammable") are all toxic and most have VRP. They give off flammable vapors when spilled which will ignite upon contact with an open flame, spark or hot surface. The vapors are usually heavier that air and will flow downhill and into depressions. Common examples are gasoline, benzene, ether, alcohol and vinyl acetate. When containers are involved in a fire, personnel should be evacuated one-half mile. All sources of ignition (e.g., smoking, internal combustion engines or welding) should be eliminated from the area where the vapors are expected to flow.

D. Nonflammable gases all have VRP and many are toxic. Many also exclude oxygen and therefore can cause asphyxiation. Gas clouds are not always visible and some have no odor. If containers are exposed to intense heat, personnel should be evacuated for one-half mile. Examples include anhydrous ammonia, hydrogen chloride and nitrous oxide. Chlorine is classed as both a Poison and Nonflammable Gas and is both toxic and VRP.

E. Flammable solids can cause fires by self-ignition or spontaneous combustion if exposed to proper conditions (e.g., getting wet, being crushed and contact with corrosives). Some have VRP. The most dangerous to firefighters are those bearing a white crossed-out W on a blue triangle in the upper portion of the placard. This symbol means "dangerous when wet." Avoid use of water in fire suppression operations near these materials. Examples include calcium carbide, magnesium, potassium, and sodium.

F. Oxidizers release oxygen when heated and, thus, greatly stimulate combustion of other fuels. All have VRP. Some, if mixed with petroleum products, become explosive (e.g., ammonium nitrate). If these materials become involved in fires, personnel should be evacuated for one-half mile. Examples include hydrogen peroxide, calcium chlorate, potassium perchlorate and urea peroxide.

G. Corrosives are all toxic. Contact with any of them can cause serious eye, skin or respiratory injury. Their fumes are usually just as toxic as the liquid and must be avoided by unprotected personnel. Since mixing with other chemicals can cause fire or explosion, spills should be contained as quickly as possible. Examples include hydrochloric acid, sulfuric acid and caustic soda.

H. Combustible liquids (placarded "Combustible") can burn when heated. If spilled, they will extend and complicate an existing fire (e.g., truck wreck). Examples include diesel fuel, antifreeze compound and cut-back asphalt.

I. Radioactive materials are all toxic. If a spill occurs, personnel should be evacuated for at least 330 feet and in case of fire, at least 1000 feet. All personnel should evacuated for one-quarter mile until the area is monitored and declared safe by specialists. If smoke clouds drift, personnel should be kept well clear of the smoke.

J. All firefighters, and anyone involved in transporting any of these hazardous materials, should learn all they can about them and keep themselves continuously updated. New materials are constantly being developed for agriculture and industry, many of which are hazardous in one way or another. Some, although common, present hazards in unusual ways that are known to only a few. One of these is chloral hydrate, which is used in large quantities by paper mills. It is usually transported as a liquid, which is relatively inert, though toxic. However,

when it is spiked, as in a wreck, it dries into a crystalline form, which is extremely flammable when exposed to abrasion. The clothing of firefighters and plant workers has been known to burst into flames from the mere act of walking after having chloral hydrate spiked on it and then drying out. Leather-soled shoes have produced similar results. Emergency information concerning specific materials can be obtained by telephoning Chemtrec.

Product Processing and Handling *14.0*

Most industrial operations in the wildlands, other than construction, produce some product, which requires processing, storage and handling. These operations not only create some fire risks themselves, but often produce conditions which make fire suppression very difficult. Since, historically, the greatest fire problems in this category have been related to forest products, the bulk of this section is devoted to them, with minor sections on other products.

I. TIMBER PROCESSING

Under this general heading will be included all types of timber processing plants, except paper or particleboard plants which use chips or other preprocessed raw materials: permanent sawmills, portable sawmills, veneer plants, shingle mills, re-manufacturing plants, molding mills, planning mills, etc. Since the waste products in these mills are small cellulosic materials (e.g., sawdust, shavings, trimmings, edgings) and often very dry, they are highly flammable. Thus, effective fire prevention and suppression measures are a must to protect the large investment involved. This is particularly true when fire-killed or insect-killed salvage lumber is being processed.

Cleanliness is the most important fire prevention measure for sawmills. Most mills have conveyor and vacuum systems to remove waste materials, but they are never 100% effective. This is particularly true of conveyors, which have a tendency to jam and overflow. Regular daily sweeping and hard pick up are required to avoid accumulations of waste in dangerous places.

Smoking is prohibited in most sawmills. This is a valuable rule, which should be enforced in all mills, on visitors as well as employees. Since the former are much harder to control than the latter, their access should be restricted to areas where fire hazards are minimal.

Mills and yards should be laid out so that adequate clearances are provided for fire equipment to work. Their designs should incorporate enough space to avoid ignition caused by radiated heat of one building, lumber stack or log deck from another or from surrounding wildland. The National Fire Protection Association (NFPA) recommends 100 feet from vegetation and a minimum of 30 feet between buildings, piles and decks.

Most modern mills are equipped with automatic fire sprinklers, fire standpipes and hydrants, hose and nozzles, fire extinguishers, etc. All mills should have these protection devices. Also it is very important that all employees, including new ones, be trained in their use and in

the fire defense roles which may be assigned to them. Formation of a company fire brigade handles this training most effectively.

In addition to the built-in fire protection discussed above, a mill should be required to have a box or cache of wildland firefighting tools sufficient to equip 50% of the employees. Employees should have training in the effective use of these tools.

Since the conversion or replacement of most steam-powered sawmills to electric power, vast quantities of waste material have required disposal. For many years, this was done primarily by burning either in open pits or in teepee burners. This was a highly hazardous practice, which caused so many fires that special fire laws may have been passed to regulate it. The restrictions were later tightened under air pollution control laws and regulations causing some operations to resort to land fills. In this activity, both water pollution and spontaneous combustion problems were encountered. Much of the waste is now processed into by-products (e.g., paper chips, synthetic fireplace logs and briquettes) and some are used as direct boiler fuel on the mill site, often for cogeneration of electric power.

Portable sawmills present special fire problems, in addition to those discussed above. By their very nature, they do not have the financial resources of large permanent mills. Therefore, they seldom have any built-in fire protection systems and cannot afford a legal waste burner. They rarely have any by-product processing ability and, thus, create a much higher proportion of flammable waste that do permanent mills. Internal combustion engines, either in direct drive or as a motor-generator set, power most portable mills. These engines are normally located at the mill site where their exhaust systems and the prevalent sawdust create a potential explosive mixture. Such mills are a serious fire hazard, both to themselves and to the surrounding country. As a minimum, they should be surrounded by a 30-foot wide firebreak. They should be kept as clean as possible while operating and the waste pile should be removed or burned during the following winter.

II. PORTABLE PROCESSING EQUIPMENT

In the world of timber harvesting, methods of operation are rapidly changing. More and more portable processing equipment is being used to process the forest products at the site where obtained. This has created new fire risks and created problems that there is no law that defines how to handle the fire risk.

One such risk which has been created is the process of chipping the material at the location obtained. If the operation is for clean chips for pulp, large piles of by product will be generated. These piles have been left behind for other processors to come in and further chip the remains for hog fuel. These piles left behind, which can exceed ten feet in height and 100 feet in length, can ignite through spontaneous combustion.

III. LOG DECKS

Log decks are to be found in three places: landings, transfer points and mill yards. Decks on landings are relatively small, continually rotated and have equipment immediately available to break them up in case of fire. They, therefore, pose only a minor fire problem.

Log decks at transfer points and in mill yards commonly contain several million board feet and may not be moved for months at a time. Unless special measures are taken they present a very serious fire problem. The most basic precaution is to keep the piles small enough and with enough separation that in case one does catch on fire the fire can be confined to that pile and not consume the entire yard. According to National Fire Protection Association (NFPA) Pamphlet 46 (1996), individual piles should never exceed 30 feet in width, 20 feet height and 500 feet in length.

Whenever an adequate water supply is available, log decks should be kept continuously wet. The moisture not only promotes fire protection, but retards blue stain and other deterioration and down-grading. If the sprinkler system is properly designed with adequate drainage

back into a sump for recirculation, the amount of water needed is greatly reduced. Still, some loss to evaporation must be expected.

Another fire safety measure for log decks is the provision of fire mains, hydrants, hose and nozzles. The initial investment for this is very high and can usually only be justified in mill yards. For basic fire protection, a hydrant system must be capable of supplying at least four (4) 21/2" hose streams simultaneously, 1000 GPM minimum, while maintaining a residual pressure in the fire protection system where large scale firefighting operations may be expected, larger water supplies with adequate mains are needed.

IV. OUTSIDE STORAGE OF WOOD CHIPS AND HOG MATERIAL

This subject is very well covered in NFPA Recommended Practice No. 46 (1996). It is recommended that anyone involved in operating or protecting such facilities become thoroughly acquainted with that publication. A few items not covered in NFPA No. 46 will be discussed here.

The practices recommended in NFPA No. 46 for chips generally apply to sawdust as well. Some differences, however, apply to stored bark chips. Bark chips, once piled, have a tendency to lock in place. They do not flow into conveyors as easily as paper chips or sawdust. Therefore, the common method of moving them out of storage is with end loaders. In the scooping operation of the loaders, a vertical, or sometimes overhanging, wall of chips often results. Oxygen then can get into the top center of the pile, and, on several occasions, has been observed to spontaneously ignite. The best protection against this phenomenon is to keep the vertical or overhanging wall from forming by continually pushing bark from the top of the pile down to the scooping area with a bulldozer or similar machine.

Not enough emphasis can be placed on close working relationships between the operator of any chip, sawdust or bark storage facility and the public fire protection agency in the area. Fire in such piles is

extremely expensive to extinguish and results in high product loss. If fires escape additional liability is incurred. It is always cheaper to prevent the fires that to experience them. However, once a fire exists, quick suppression, while the fire is still very small, is the cheapest method. The local fire chief, ranger or fire marshal can help with either of these goals.

V. ORE AND AGGREGATE PLANTS

The products of ore and aggregate plants are generally nonflammable. Therefore, the fire problems involved mostly relate to the structure and machinery and basically are no different from those of any other industrial plant. An exception is that they are often in isolated or remote locations where public fire suppression forces are unavailable or not suited to structural protection. A good built-in fire protection system and a company fire brigade become very important. Assistance in these matters can be obtained from local fire authorities, insurance companies and consulting fire protection engineers.

VI. OIL AND GAS

Almost all processing and storage of petroleum and natural gas is done at locations remote from the producing wells and usually outside of forest and watershed areas. Storage and transportation of consumer products is discussed in the section on “Commercial Transportation and Storage.” Fire safety in pumping plants is so critical to personnel and capital safety, that it is adequately provided for in governmental regulations, insurance company requirements and operating company rules. Thus, the fire threat to wildlands is minimal.

VII. ELECTRICAL POWER USE

Almost all modern industrial plants, wherever located, are powered by electricity. In many respects, this type of power is more fire safe than steam or internal combustion, providing adequate standards are employed in construction and maintenance. Even if not required by local ordinance, use of one of the recognized electrical codes is recommended.